ALBERUNI'S INDIA.

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LAWS AND ASTROLOGY OF INDIA
ABOUT A.D. 1030.

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ALBÊRÛNÎ'S INDIA.

CHAPTER XLIX.

A SUMMARY DESCRIPTION OF THE ERAS.

Page 203. Enumeration of some of the eras of the Hindus.

THE eras serve to fix certain moments of time which are mentioned in some historical or astronomical connection. The Hindus do not consider it wearisome to reckon with huge numbers, but rather enjoy it. Still, in practical use, they are compelled to replace them by smaller (more handy) ones.

Of their eras we mention—

1. The beginning of the existence of Brahman.

2. The beginning of the day of the present nychthemeron of Brahman, *i.e.* the beginning of the *kalpa*.

3. The beginning of the seventh *manvantara*, in which we are now.

4. The beginning of the twenty-eighth *caturyuga*, in which we are now.

5. The beginning of the fourth *yuga* of the present *caturyuga*, called *kalikâla*, *i.e.* the time of Kali. The whole *yuga* is called after him, though, accurately speaking, *his* time falls only in the last part of the *yuga*. Notwithstanding, the Hindus mean by *kalikâla* the beginning of the *kaliyuga*.

6. *Pâṇḍava-kâla*, *i.e.* the time of the life and the wars of Bhârata.

All these eras vie with each other in antiquity, the one going back to a still more remote beginning than the other, and the sums of years which they afford go beyond hundreds, thousands, and higher orders of numbers. Therefore not only astronomers, but also other people, think it wearisome and unpractical to use them.

The author adopts the year 400 of Yazdajird as a test-year.

In order to give an idea of these eras, we shall use as a first gauge or point of comparison that Hindu year the great bulk of which coincides with the *year 400 of Yazdajird.* This number consists only of hundreds, not of units and tens, and by this peculiarity it is distinguished from all other years that might possibly be chosen. Besides, it is a memorable time; for the breaking of the strongest pillar of the religion, the decease of the pattern of a prince, Maḥmûd, the lion of the world, the wonder of his time—may God have mercy upon him!—took place only a short time, less than a year, before it. The Hindu year precedes the Naurôz or new year's day of this year only by twelve days, and the death of the prince occurred precisely ten complete Persian months before it.

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Now, presupposing this our gauge as known, we shall compute the years for this point of junction, which is the beginning of the corresponding Hindu year, for the end of all years which come into question coincides with it, and the Naurôz of the year 400 of Yazdajird falls only a little latter (viz. twelve days).

How much of the life of Brahman has elapsed according to the *Vishṇu-Dharma.*

The book *Vishṇu-Dharma* says: "Vajra asked Mârkaṇḍeya how much of the life of Brahman had elapsed; whereupon the sage answered: 'That which has elapsed is 8 years, 5 months, 4 days, 6 *manvantaras*, 7 *saṁdhi*, 27 *caturyugas*, and 3 *yugas* of the twenty-eighth *caturyuga*, and 10 *divya-years* up to the time of the *aśvamedha* which thou hast offered.' He who knows the details of this statement and comprehends them duly is a *sage* man, and *the sage* is he who serves the only Lord and strives to reach the neighbourhood of his place, which is called *Paramapada.*"

Presupposing this statement to be known, and referring the reader to our explanation of the various measures of time which we have given in former chapters, we offer the following analysis.

Of the life of Brahman there have elapsed before our gauge 26,215,732,948,132 of our years. Of the nychthemeron of Brahman, *i.e.* of the *kalpa of the day*, there have elapsed 1,972,948,132, and of the seventh *manvantara* 120,532,132.

The latter is also the date of the imprisoning of the King Bali, for it happened in the first *caturyuga* of the seventh *manvantara*.

In all chronological dates which we have mentioned already and shall still mention, we only reckon with *complete* years, for the Hindus are in the habit of disregarding *fractions* of a year.

The time of Râma according to *Vishṇu-Dharma*.

Further, the *Vishṇu-Dharma* says: "Mârkaṇḍeya says, in answer to a question of Vajra, 'I have already lived as long as 6 *kalpas* and 6 *manvantaras* of the seventh *kalpa*, 23 *tretâyugas* of the seventh *manvantara*. In the twenty-fourth *tretâyuga* Râma killed Râvaṇa, and Lakshmaṇa, the brother of Râma, killed Kumbhakarṇa, the brother of Râvaṇa. The two subjugated all the Râkshasas. At that time Vâlmiki, the Ṛishi, composed the story of Râma and Râmâyaṇa and eternalised it in his books. It was I who told it to Yudhishṭhira, the son of Pâṇḍu, in the forest of Kâmyakavana.'"

The author of the *Vishṇu-Dharma* reckons here with *tretâyugas*, first, because the events which he mentions occurred in a certain *tretâyuga*, and secondly, because it is more convenient to reckon with a simple unit than with such a unit as requires to be explained by reference to its single quarters. Besides, the latter part of the *tretâyuga* is a more suitable time for the events mentioned than its beginning, because it is so much nearer to the age of evil-doing (v. i. pp. 379, 380). No doubt, the date of Râma and Râmâyaṇa is known among the

Hindus, but I for my part have not been able to ascertain it.

Twenty-three *caturyugas* are 99,360,000 years, and, together with the time from the beginning of a *caturyuga* till the end of the *tretâyuga*, 102,384,000 years.

If we subtract this number of years from the number of years of the seventh *manvantara* that have elapsed before our gauge-year, viz. 120,532,132 (v. p. 3), we get the remainder of 18,148,132 years, *i.e.* so many years before our gauge-year as the conjectural date of Râma; and this may suffice, as long as it is not supported by a trustworthy tradition. The here-mentioned year corresponds to the 3,892,132d year of the 28th *caturyuga*.

How much time has elapsed before o of the present *kalpa*, according to Pulisa and Brahmagupta.

All these computations rest on the measures adopted by Brahmagupta. He and Pulisa agree in this, that the number of *kalpas* which have elapsed of the life of Brahman before the present *kalpa* is 6068 (equal to 8 years, 5 months, 4 days of Brahman). But they differ from each other in converting this number into *caturyugas*. According to Pulisa, it is equal to 6,116,544; according to Brahmagupta, only to 6,068,000 *caturyugas*. Therefore, if we adopt the system of Pulisa, reckoning 1 *manvantara* as 72 *caturyugas* without *saṁdhi*, 1 *kalpa* as 1008 *caturyugas*, and each *yuga* as the fourth part of a *caturyuga*, that which has elapsed of the life of Brahman before our gauge-year is the sum of 26,425,456,204,132 (!) years, and of the *kalpa* there have elapsed 1,986,124,132 years, of the *manvantara* 119,884,132 years, and of the *caturyuga* 3,244,132 years.

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How much time has elapsed of the current *kaliyuga*.

Regarding the time which has elapsed since the beginning of the *kaliyuga*, there exists no difference amounting to whole years. According to both Brahmagupta and Pulisa, of the *kaliyuga* there have elapsed before our gauge-year 4132 years, and between the wars of Bhârata and our gauge-year there have elapsed 3479 years. The year 4132 before the gauge-year is the epoch of the *kalikâla*, and the year 3479 before the gauge-year is the epoch of the *Pâṇḍavakâla*.

The era Kâlayavana.

The Hindus have an era called *Kâlayavana*, regarding which I have not been able to obtain full information. They place its epoch in the end of the last *dvâparayuga*. The here-mentioned Yavana (JMN) severely oppressed both their country and their religion.

To date by the here-mentioned eras requires in any case vast numbers, since their epochs go back to a most remote antiquity. For this reason people have given up using them, and have adopted instead the eras of—

(1.) *Śrî Harsha.*
(2.) *Vikramâditya.*
(3.) *Śaka.*
(4.) *Valabha*, and
(5.) *Gupta.*

Era of Śrî Harsha.

The Hindus believe regarding Śrî Harsha that he used to examine the soil in order to see what of hidden treasures was in its interior, as far down as the seventh earth; that, in fact, he found such treasures; and that, in consequence, he could dispense with oppressing his subjects (by taxes, &c.) His era is used in Mathurâ and the country of Kanoj. Between Śrî Harsha and Vikramâditya there is an interval of 400 years, as I have been told by some of the inhabitants of that region. However, in the Kashmîrian calendar I have read that Śrî Harsha was 664 years later than Vikramâditya. In face of this discrepancy I am in perfect uncertainty, which to the present moment has not yet been cleared up by any trustworthy information.

Era of Vikramâditya.

Those who use the era of Vikramâditya live in the southern and western parts of India. It is used in the following way: 342 are multiplied by 3, which gives the product 1026. To this number you add the years which have elapsed of the current *shashṭyabda* or sexagesimal *samvatsara*, and the sum is the corresponding year of the era of Vikramâditya. In the book *Srûdhava* by Mahâdeva I find as his name *Candrabîja*.

As regards this method of calculation, we must first say that it is rather awkward and unnatural, for if they began with 1026 as the basis of the calculation, as they begin—without any apparent necessity—with 342, this would serve the same purpose. And, secondly, admitting that the method is correct as long as there is only *one shashṭyabda* in the date, how are we to reckon if there is a number of *shashṭyabdas?*

The Śakakâla.

The epoch of the era of Śaka or Śakakâla falls 135 years later than that of Vikramâditya. The here-mentioned Śaka tyrannised over their country between the river Sindh and the ocean, after he had made Âryavarta in the midst of this realm his dwelling-place. He interdicted the Hindus from considering and representing themselves as anything but Śakas. Some maintain that he was a Śûdra from the city of Almanṣûra; others maintain that he was not a Hindu at all, and that he had come to India from the west. The Hindus had much to suffer from him, till at last they received help from the east, when Vikramâditya marched against him, put him to flight and killed him in the region of Karûr, between Multân and the castle of Lônî. Now this date became famous, as people rejoiced in the news of the death of the tyrant, and was used as the epoch of an era, especially by the astronomers. They honour the conqueror by adding Śrî to his name, so as to say Śrî Vikramâditya. Since there is a long interval between the era which is called the era of Vikramâditya (v. p. 5) and the killing of Śaka, we think that that Vikramâditya from whom the era has got its name is not identical with that one who killed Śaka, but only a namesake of his.

Era of Valabha.

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The era of Valabha is called so from Valabha, the ruler of the town Valabhî, nearly 30 *yojanas* south of Anhilvâra. The epoch of this era falls 241 years later than the epoch of the Śaka era. People use it in this way. They first put down the year of the Śakakâla, and then subtract from it the cube of 6 and the square of 5 (216 + 25 = 241). The remainder is the year of the Valabha era. The history of Valabha is given in its proper place (cf. chap. xvii.)

Guptakâla.

As regards the Guptakâla, people say that the Guptas were wicked powerful people, and that when they ceased to exist this date was used as the epoch of an era. It seems that Valabha was the last of them, because the epoch of the era of the Guptas falls, like that of the Valabha era, 241 years later than the Śakakâla.

Era of the astronomers.

The *era of the astronomers* begins 587 years later than the Śakakâla. On this era is based the canon *Khaṇḍakhâdyaka* by Brahmagupta, which among Muhammadans is known as *Al-arkand.*

Comparison of the epochs of the Indian eras with the test-year.

Now, the year 400 of Yazdajird, which we have chosen as a gauge, corresponds to the following years of the Indian eras:—

(1) To the year 1488 of the era of Śrî Harsha,
(2) To the year 1088 of the era of Vikramâditya,
(3) To the year 953 of the Śakakâla,
(4) To the year 712 of the Valabha era, which is identical with the Guptakâla,
(5) To the year 366 of the era of the canon *Khaṇḍakhâdyaka,*
(6) To the year 526 of the era of the canon *Pañcasiddhântikâ* by Varâhamihira,
(7) To the year 132 of the era of the canon *Karaṇasâra;* and
(8) To the year 65 of the era of the canon *Karaṇatilaka.*

The eras of the here-mentioned *canones* are such as the authors of them considered the most suitable to be used as cardinal points in astronomical and other calculations, whence calculation may conveniently extend forward or backward. Perhaps the epochs of these eras fall within the time when the authors in question themselves lived, but it is also possible that they fall within a time anterior to their lifetime.

On the popular mode of dating by *centennia* or *samvatsaras*.

Common people in India date by the years of a *centennium*, which they call *samvatsara*. If a *centennium* is finished, they drop it, and simply begin to date by a new one. This era is called *lokakâla*, *i.e.* the era of the nation at large. But of this era people give such totally different accounts, that I have no means of making out the truth. In a similar manner they also differ among themselves regarding the beginning of the year. On the latter subject I shall communicate what I have heard myself, hoping meanwhile that one day we shall be able to discover a rule in this apparent confusion.

Different beginnings of the year.

Those who use the Śaka era, the astronomers, begin the year with the month Caitra, whilst the inhabitants of Kanîr, which is conterminous with Kashmîr, begin it with the month Bhâdrapada. The same people count our gauge-year (400 Yazdajird) as the eighty-fourth year of an era of theirs.

All the people who inhabit the country between Bardarî and Mârîgala begin the year with the month Kârttika, and they count the gauge-year as the 110th year of an era of theirs. The author of the Kashmirian calendar maintains that the latter year corresponds to the sixth year of a new *centennium*, and this, indeed, is the usage of the people of Kashmîr.

The people living in the country Nîrahara, behind Mârîgala, as far as the utmost frontiers of Tâkeshar and Lohâvar, begin the year with the month Mârgaśîrsha, and reckon our gauge-year as the 108th year of their era. The people of *Lanbaga, i.e.* Lamghân, follow their example. I have been told by people of Multân that this system is peculiar to the people of Sindh and Kanoj, and that they used to begin the year with the new moon of Mârgaśîrsha, but that the people of Multân only a few years ago had given up this system, and had adopted the system of the people of Kashmîr, and followed their example in beginning the year with the new moon of Caitra.

Popular mode of dating in use among the Hindus, and criticisms thereon.

I have already before excused myself on account of the imperfection of the information given in this chapter. For we cannot offer a strictly scientific account of the eras to which it is devoted, simply because in them we have to reckon with periods of time far exceeding a *centennium*, (and because all tradition of events farther back than a hundred years is confused (v. p. 8).) So I have myself seen the roundabout way in which they compute the year of the destruction of Somanâth in the year of the Hijra 416, or 947 Śakakâla. First, they write down the number 242, then under it 606, then under this 99. The sum of these numbers is 947, or the year of the Śakakâla.

Now I am inclined to think that the 242 years have elapsed before the beginning of their centennial system, and that they have adopted the latter together with the Guptakâla; further, that the number 606 represents complete *samvatsaras* or centennials, each of which they must reckon as 101 years; lastly, that the 99 years represent that time which has elapsed of the current *centennium.*

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That this, indeed, is the nature of the calculation is confirmed by a leaf of a canon composed by Durlabha of Multân, which I have found by chance. Here the author says: "First write 848 and add to it the *laukika-kâla, i.e.* the era of the people, and the sum is the Śakakâla."

If we write first the year of the Śakakâla corresponding to our gauge-year, viz. 953, and subtract 848 from it, the remainder, 105, is the year of the *laukika-kâla*, whilst the destruction of Somanâth falls in the ninety-eighth year of the *centennium* or *laukika-kâla*.

Durlabha says, besides, that the year begins with the month Mârgaśîrsha, but that the astronomers of Multân begin it with Caitra.

Origin of the dynasty of the Shâhs of Kâbul.

The Hindus had kings residing in Kâbul, Turks who were said to be of Tibetan origin. The first of them, Barhatakin, came into the country and entered a cave in Kâbul, which none could enter except by creeping on hands and knees. The cave had water, and besides he deposited there victuals for a certain number of days. It is still known in our time, and is called *Var*. People who consider the name of Barhatakin as a good omen enter the cave and bring out some of its water with great trouble.

Certain troops of peasants were working before the door of the cave. Tricks of this kind can only be carried out and become notorious, if their author has made a secret arrangement with somebody else — in fact, with confederates. Now these had induced persons to work there continually day and night in turns, so that the place was never empty of people.

Some days after he had entered the cave, he began to creep out of it in the presence of the people, who looked on him as a new-born baby. He wore Turkish dress, a short tunic open in front, a high hat, boots and arms. Now people honoured him as a being of miraculous origin, who had been destined to be king, and in fact he brought those countries under his sway and ruled them under the title of a *shâhiya of Kâbul*. The rule remained among his descendants for generations, the number of which is said to be about sixty.

Unfortunately the Hindus do not pay much attention to the historical order of things, they are very careless in relating the chronological succession of their kings, and when they are pressed for information and are at a loss, not knowing what to say, they invariably take to tale-telling. But for this, we should communicate to the reader the traditions which we have received from some people among them. I have been told that the pedigree of this royal family, written on silk, exists in the fortress *Nagarkot*, and I much desired to make myself acquainted with it, but the thing was impossible for various reasons.

The story of Kanik.

One of this series of kings was Kanik, the same who is said to have built the *vihâra* (Buddhistic monastery) of Purushâvar. It is called, after him, *Kanik-caitya*. People relate that the king of Kanoj had presented to him, among other gifts, a gorgeous and most singular piece of cloth. Now Kanik wanted to have dresses made out of it for himself, but his tailor had not the courage to make them, for he said, "There is (in the embroidery) the figure of a human foot, and whatever trouble I may take, the foot will always lie between the shoulders." And that means the same as we have already mentioned in the story of Bali, the son of Virocana (*i.e.* a sign of subjugation, cf. i. p. 397). Now Kanik felt convinced that the ruler of Kanoj had thereby intended to vilify and disgrace him, and in hot haste he set out with his troops marching against him.

When the *râî* heard this, he was greatly perplexed, for he had no power to resist Kanik. Therefore he consulted his Vazîr, and the latter said, "You have roused a man who was quiet before, and have done unbecoming things. Now cut off my nose and lips, let me be mutilated, that I may find a cunning device; for there is no possibility of an open resistance." The *râî* did with him as he had proposed, and then he went off to the frontiers of the realm.

There he was found by the hostile army, was recognised and brought before Kanik, who asked what was the matter with him. The Vazîr said, "I tried to dissuade *him* from opposing you, and sincerely advised him to be obedient to you. He, however, conceived a suspicion against me and ordered me to be mutilated. Since then he has gone, of his own accord, to a place which a man can only reach by a very long journey when he marches on the highroad, but which he may easily reach by undergoing the trouble of crossing an intervening desert, supposing that he can carry with himself water for so and so many days." Thereupon Kanik answered: "The latter is easily done." He ordered water to be carried along, and engaged the Vazîr to show him the road. The Vazîr marched before the king and led him into a boundless desert. After the number of days had elapsed and the road did not come to an end, the king asked the Vazîr what was now to be done. Then the Vazîr said, "No blame attaches to me that I tried to save my master and to destroy his enemy. The nearest road leading out of this desert is that on which you have come. Now do with me as you like, for none will leave this desert alive."

Then Kanik got on his horse and rode round a depression in the soil. In the centre of it he thrust his spear into the earth, and lo! water poured from it in sufficient quantity for the army to drink from and to draw from for the march back. Upon this the Vazîr said, "I had not directed my cunning scheme against powerful angels, but against feeble men. As things stand thus, accept my intercession for the prince, my benefactor, and pardon him." Kanik answered, "I
Page 208. march back from this place. Thy wish is granted to thee. Thy master has already received what is due to him." Kanik returned out of the desert, and the Vazîr went back to his master, the *râî* of Kanoj. There he

found that on the same day when Kanik had thrust his spear into the earth, both the hands and feet had fallen off the body of the *rât*.

End of the Tibetan dynasty, and origin of the Brahman dynasty.

The last king of this race was *Lagatûrmân*, and his Vazîr was Kallar, a Brahman. The latter had been fortunate, in so far as he had found by accident hidden treasures, which gave him much influence and power. In consequence, the last king of this Tibetan house, after it had held the royal power for so long a period, let it by degrees slip from his hands. Besides, Lagatûrmân had bad manners and a worse behaviour, on account of which people complained of him greatly to the Vazîr. Now the Vazîr put him in chains and imprisoned him for correction, but then he himself found ruling sweet, his riches enabled him to carry out his plans, and so he occupied the royal throne. After him ruled the Brahman kings Sâmand (Sâmanta), Kamalû, Bhîm (Bhîma), Jaipâl (Jayapâla), Ânandapâla, Tarojanapâla (Trilocanapâla). The latter was killed A.H. 412 (A.D. 1021), and his son Bhîmapâla five years later (A.D. 1026).

This Hindu Shâhiya dynasty is now extinct, and of the whole house there is no longer the slightest remnant in existence. We must say that, in all their grandeur, they never slackened in the ardent desire of doing that which is good and right, that they were men of noble sentiment and noble bearing. I admire the following passage in a letter of Ânandapâla, which he wrote to the prince Maḥmûd, when the relations between them were already strained to the utmost: "I have learned that the Turks have rebelled against you and are spreading in Khurâsân. If you wish, I shall come to you with 5000 horsemen, 10,000 foot-soldiers, and 100 elephants, or, if you wish, I shall send you my son with double the number. In acting thus, I do not speculate on the impression which this will make on you. I have been conquered by *you*, and therefore I do not wish that another man should conquer you."

The same prince cherished the bitterest hatred against the Muhammadans from the time when his son was made a prisoner, whilst his son Tarojanapâla (Trilocanapâla) was the very opposite of his father.

CHAPTER L.

HOW MANY STAR-CYCLES THERE ARE BOTH IN A "KALPA" AND IN A "CATURYUGA."

It is one of the conditions of a *kalpa* that in it the planets, with their apsidea and nodes, must unite in 0° of Aries, *i.e.* in the point of the vernal equinox. Therefore each planet makes within a *kalpa* a certain number of complete revolutions or cycles.

The tradition of Alfazârî and Ya'ḳûb Ibn Târiḳ.

These star-cycles as known through *the canon* of Alfazârî and Ya'ḳûb Ibn Târiḳ, were derived from a Hindu who came to Bagdad as a member of the political mission which Sindh sent to the Khalif Almanṣûr, A.H. 154 (= A.D. 771). If we compare these secondary statements with the primary statements of the Hindus, we discover discrepancies, the cause of which is not known to me. Is their origin due to the translation of Alfazârî and Ya'ḳûb? or to the dictation of that Hindu? or to the fact that afterwards these computations have been corrected by Brahmagupta, or some one else? For, certainly, any scholar who becomes aware of mistakes in astronomical computations and takes an interest in the subject, will endeavour to correct them, as, *e.g.* Muḥammad Ibn Isḥâḳ of Sarakhs has done. For he had discovered in the computation of Saturn a falling back behind real time (*i.e.*, that Saturn, according to this computation, revolved slower than it did in reality). Now he assiduously studied the subject, till at last he was convinced that his fault did not originate

Muḥammad Ibn Isḥâḳ of Sarakhs.

from the *equation* (*i.e.* from the correction of the places of the stars, the computation of their mean places). Then he added to the cycles of Saturn one cycle more, and compared his calculation with the actual motion of the planet, till at last he found the calculation of the cycles completely to agree with astronomical observation. In accordance with this correction he states the star-cycles in his *canon*.

Âryabhaṭa quoted by Brahmagupta. Brahmagupta relates a different theory regarding the cycles of the apsides and nodes of the moon, on the authority of Âryabhaṭa. We quote this from Brahmagupta, for we could not read it in the original work of Âryabhaṭa, but only in a quotation in the work of Brahmagupta.

Number of the rotations of the planets in a *kalpa*. Page 209. The following table contains all these traditions, which will facilitate the study of them, if God will!

The planets.		Number of their revolutions in a Kalpa.	Number of the revolutions of their apsides.	Number of the revolutions of their nodes.
Sun		4,320,000,000	480	Has no node.
Moon.	Brahmagupta	57,753,300,000	488,105,858	232,311,168
	The translation of Alfazârî			232,312,138
	Âryabhaṭa		488,219,000	232,316,000
	The anomalistic revolution of the moon according to Brahmagupta		57,265,194,142	The anomalistic revolution of the moon is here treated as if it were the apsis, being the difference between the motion of the moon and that of the apsis. (See the *notes*.)
Mars		2,296,828,522	292	267
Mercury		17,936,998,984	332	521
Jupiter		364,226,455	855	63
Venus		7,022,389,492	653	893
Saturn.	Brahmagupta	146,567,298	41	584
	The translation of Alfazârî	146,569,284		
	The correction of Alsarakhsî	146,569,238		
The fixed stars		120,000 according to the translation of Alfazârî.		

Cycles of the planets in a *caturyuga* and *kaliyuga*.

The computation of these cycles rests on the mean motion of the planets. As a *caturyuga* is, according to Brahmagupta, the one-thousandth part of a *kalpa*, we have only to divide these cycles by 1000, and the quotient is the number of the star-cycles in one *caturyuga*.

Likewise, if we divide the cycles of the table by 10,000, the quotient is the number of the star-cycles in a *kaliyuga*, for this is one-tenth of a *caturyuga*. The fractions which may occur in those quotients are raised to wholes, to *caturyugas* or *kaliyugas*, by being multiplied by a number equal to the denominator of the fraction.

The following table represents the star-cycles specially in a *caturyuga* and *kaliyuga*, not those in a *manvantara*. Although the *manvantaras* are nothing but multiplications of whole *caturyugas*, still it is difficult to reckon with them on account of the *saṁdhi* which is attached both to the beginning and to the end of them.

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The names of the planets.	Their revolutions in a Caturyuga.	Their revolutions in a Kaliyuga.
Sun	4,320,000	432,000
His apsis	$0\frac{12}{25}$	$0\frac{60}{1250}$
Moon	57,753,300	5,775,330
Her apsis — Brahmagupta	$488,105\frac{429}{500}$	$48,810\frac{2929}{5000}$
Āryabhaṭa	488,219	$48,821\frac{9}{10}$
Her anomalistic revolution	$57,265,194\frac{71}{500}$	$5,726,519\frac{2071}{5000}$
Her node — Brahmagupta	$232,311\frac{21}{125}$	$23,231\frac{292}{2500}$
The translation of Alfazârî	$232,312\frac{69}{500}$	$23,231\frac{1069}{5000}$
Āryabhaṭa	232,316	$23,231\frac{3}{5}$
Mars	$2,296,828\frac{261}{500}$	$229,682\frac{4261}{5000}$
His apsis	$0\frac{73}{250}$	$0\frac{73}{2500}$
His node	$0\frac{267}{1000}$	$0\frac{267}{10000}$
Mercury	$17,936,998\frac{123}{125}$	$1,793,699\frac{1123}{1250}$
His apsis	$0\frac{83}{250}$	$0\frac{83}{2500}$
His node	$0\frac{521}{1000}$	$0\frac{521}{10000}$
Jupiter	$364,226\frac{91}{200}$	$36,422\frac{1291}{2000}$
His apsis	$0\frac{171}{200}$	$0\frac{171}{2000}$
His node	$0\frac{63}{1000}$	$0\frac{63}{10000}$

The names of the planets.	Their revolutions in a Caturyuga.	Their revolutions in a Kaliyuga.
Venus	$7,022,389\frac{123}{250}$	$702,238\frac{2373}{2500}$
Her apsis	$0\frac{653}{1000}$	$0\frac{653}{10000}$
Her node	$0\frac{893}{1000}$	$0\frac{893}{10000}$
Saturn	$146,567\frac{149}{500}$	$14,656\frac{3649}{5000}$
His apsis	$0\frac{41}{1000}$	$0\frac{41}{10000}$
His node	$0\frac{73}{125}$	$0\frac{73}{1250}$
Saturn: The translation of Alfazârî	$146,569\frac{71}{250}$	$14,656\frac{2321}{2500}$
Saturn: The correction of Alsarakhsî	$146,569\frac{119}{500}$	$14,656\frac{4619}{5000}$
The fixed stars	120	12

Page 11. Star-cycles of a *kalpa* and *caturyuga*, according to Pulisa.

After we have stated how many of the star-cycles of a *kalpa* fall in a *caturyuga* and in a *kaliyuga*, according to Brahmagupta, we shall now derive from the number of star-cycles of a *caturyuga* according to Pulisa the number of star-cycles of a *kalpa*, first reckoning a *kalpa* = 1000 *caturyugas*, and, secondly, reckoning it as 1008 *caturyugas*. These numbers are contained in the following table:—

The Yugas according to Pulisa.

The names of the 8 planets.	Number of their revolutions in a Caturyuga.	Number of their revolutions in a Kalpa of 1000 Caturyugas.	Number of their revolutions in a Kalpa of 1008 Caturyugas.
Sun	4,320,000	4,320,000,000	4,354,560,000
Moon	57,753,336	57,753,336,000	58,215,362,688
Her apsis	488,219	488,219,000	492,124,752
Her node	232,226	232,226,000	234,083,808
Mars	2,296,824	2,296,824,000	2,315,198,592
Mercury	17,937,000	17,937,000,000	18,080,496,000
Jupiter	364,220	364,220,000	367,133,760
Venus	7,022,388	7,022,388,000	7,078,567,104
Saturn	146,564	146,564,000	147,736,512

Transformation of the word Âryabhaṭa among the Arabs.

We meet in this context with a curious circumstance. Evidently Alfazârî and Ya'ḳûb sometimes heard from their Hindu master expressions to this effect, that his calculation of the star-cycles was that of *the great Siddhânta, whilst Âryabhaṭa reckoned with one-thousandth* *part of it.* They apparently did not understand him properly, and imagined that *âryabhaṭa* (Arab. *ârjabhad*) meant *a thousandth part.* The Hindus pronounce the *ḍ* of this word something between a *d* and an *r*. So the consonant became changed to an *r*, and people wrote *ârjabhar.* Afterwards it was still more mutilated, the first *r* being changed to a *z*, and so people wrote *âzjabhar.* If the word in this garb wanders back to the Hindus, they will not recognise it.

Star-cycles according to Abû-alḥasan of Al'ahwâz.

Further, Abû-alḥasan of Al'ahwâz mentions the revolutions of the planets in *the years of al-arjabhar, i.e.* in *caturyugas.* I shall represent them in the table such as I have found them, for I guess that they are directly derived from the dictation of that Hindu. Possibly, therefore, they give us the theory of Âryabhaṭa. Some of these numbers agree with the star-cycles in a *caturyuga,* which we have mentioned on the authority of Brahmagupta; others differ from them, and agree with the theory of Pulisa; and a third class of numbers differs from those of both Brahmagupta and Pulisa, as the examination of the whole table will show.

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The names of the planets.	Their Yugas as parts of a Caturyuga according to Abû-alḥasan Al'ahwâz.
Sun	4,320,000
Moon	57,753,336
Her apsis . .	488,219
Her node . .	232,226
Mars	2,296,828
Mercury . . .	17,937,020
Jupiter . . .	364,224
Venus	7,022,388
Saturn . . .	146,564

CHAPTER LI.

AN EXPLANATION OF THE TERMS "ADHIMÂSA," "ÛNARÂTRA," AND THE "AHARGAṆAS," AS REPRESENTING DIFFERENT SUMS OF DAYS.

On the leap month.

THE months of the Hindus are lunar, their years solar; therefore their new year's day must in each solar year fall by so much earlier as the lunar year is shorter than the solar (roughly speaking, by eleven days). If this precession makes up one complete month, they act in the same way as the Jews, who make the year a leap year of thirteen months by reckoning the month Adar twice, and in a similar way to the heathen Arabs, who in a so-called *annus procrastinationis* postponed the new year's day, thereby extending the preceding year to the duration of thirteen months.

The Hindus call the year in which a month is repeated in the common language *malamâsa*. *Mala* means the dirt that clings to the hand. As such dirt is thrown away, thus the leap month is thrown away out of the calculation, and the number of the months of a year remains twelve. However, in the literature the leap month is called *adhimâsa*.

That month is repeated within which (it being considered as a solar month) two lunar months finish. If the end of the lunar month coincides with the beginning of the solar month, if, in fact, the former ends before any part of the latter has elapsed, this month is repeated, because the end of the lunar month, although it has not yet run into the new solar month, still does no longer form part of the preceding month.

If a month is repeated, the first time it has its ordinary name, whilst the second time they add before the name the word *durâ* to distinguish between them. If, *e.g.* the month Âshâḍha is repeated, the first is called Âshâḍha, the second *Durâshâḍha*. The first month is that which is disregarded in the calculation. The Hindus consider it as unlucky, and do not celebrate any of the festivals in it which they celebrate in the other months. The most unlucky time in this month is that day on which the lunation reaches its end.

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Quotation from the *Vishṇu-Dharma*.

The author of the *Vishṇu-Dharma* says: "*Candra* (*mâna*) is smaller than *sâvana*, *i.e.* the lunar year is smaller than the civil year, by six days, *i.e. ûnarâtra*. *Ûna* means *decrease, deficiency*. *Saura* is greater than *candra* by eleven days, which gives in two years and seven months the supernumerary *adhimâsa* month. This whole month is unlucky, and nothing must be done in it."

This is a rough description of the matter. We shall now describe it accurately.

The lunar year has 360 lunar days, the solar year has $371\frac{31}{480}$ lunar days. This difference sums up to the thirty days of an *adhimâsa* in the course of $976\frac{4176}{47799}$ lunar days, *i.e.* in 32 months, or in 2 years, 8 months, 16 days, *plus* the fraction: $\frac{4176}{47799}$ lunar day, which is nearly = 5 minutes, 15 seconds.

Quotation from the *Veda*.

As the religious reason of this theory of intercalation the Hindus mention a passage of the *Veda*, which they have read to us, to the following tenor: "If the day of conjunction, *i.e.* the first lunar day of the month, passes without the sun's marching from one zodiacal sign to the other, and if this takes place on the following day, the preceding month falls out of the calculation."

Criticisms thereon.

The meaning of this passage is not correct, and the fault must have risen with the man who recited and translated the passage to me. For a month has thirty lunar days, and a twelfth part of the solar year has $30\frac{5311}{5760}$ lunar days. This fraction, reckoned in day-minutes, is equal to $55^{\text{i}}\ 19^{\text{ii}}\ 22^{\text{iii}}\ 30^{\text{iv}}$. If we now, for example, suppose a conjunction or new moon to take place at 0° of a zodiacal sign, we add this fraction to the time of the conjunction, and thereby we find the times of the sun's entering the signs successively. As now the difference between a lunar and a solar month is only a fraction of a day, the sun's entering a new sign may naturally take place on any of the days of the month. It may even happen that the sun enters two consecutive signs on the same month-day (*e.g.* on the second or third of two consecutive months). This is the case if in one month the sun enters a sign before $4^{\text{i}}\ 40^{\text{ii}}\ 37^{\text{iii}}\ 30^{\text{iv}}$ have elapsed of it; for the next following entering a sign falls later by $55^{\text{i}}\ 19^{\text{ii}}\ 23^{\text{iii}}\ 30^{\text{iv}}$, and both these fractions (*i.e.* less than $4^{\text{i}}\ 40^{\text{ii}}\ 37^{\text{iii}}\ 30^{\text{iv}}$ *plus* the last-mentioned fraction) added together are not sufficient to make up one complete day. Therefore the quotation from the *Veda* is not correct.

Proposed explanation of the Vedic passage.

I suppose, however, that it may have the following correct meaning:—If a month elapses in which the sun does not march from one sign to another, this month is disregarded in the calculation. For if the sun enters a sign on the 29th of a month, when at least $4^{\text{i}}\ 40^{\text{ii}}\ 37^{\text{iii}}\ 30^{\text{iv}}$ have elapsed of it, this entering takes place before the beginning of the succeeding month, and therefore the latter month is without an entering of the sun into a new sign, because the next following entering falls on the first of the next but one or third month. If you compute the consecutive enterings, beginning with a conjunction taking place in 0° of a certain sign, you find that in the thirty-third month the sun enters a new sign at $30^{\text{i}}\ 20^{\text{ii}}$ of the twenty-ninth day, and that he enters the next following sign at $25^{\text{i}}\ 39^{\text{ii}}\ 22^{\text{iii}}\ 30^{\text{iv}}$ of the first day of the thirty-fifth month.

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Hence also becomes evident why this month, which is disregarded in the calculation, is considered as unlucky. The reason is that the month misses just that moment which is particularly adapted to earn in it a heavenly reward, viz. the moment of the sun's entering a new sign.

As regards *adhimâsa*, the word means *the first month*, for AD means *beginning* (*i.e. âdi*). In the books of Ya'ḳûb Ibn Ṭâriḳ and of Alfazârî this name is written *padamâsa*. *Pada* (in the orig. *P–Dh*) means *end*, and it is possible that the Hindus call the leap month by both names; but the reader must be aware that these two authors frequently misspell or disfigure the Indian words, and that there is no reliance on their tradition. I only mention this because Pulisa explains the latter of the *two* months, which are called by the same name, as the supernumerary one.

Explanation of the terms *universal* or *partial* months and days.

The month, as the time from one conjunction to the following, is one revolution of the moon, which revolves through the ecliptic, but in a course distant from that of the sun. This is the difference between the motions of the two heavenly luminaries, whilst the direction in which they move is the same. If we subtract the revolutions of the sun, *i.e.* the solar cycles of a *kalpa*, from its lunar cycles, the remainder shows how many more lunar months a *kalpa* has than solar months. All months or days which we reckon as parts of whole *kalpas* we call here *universal*, and all months or days which we reckon as parts of a part of a *kalpa*, *e.g.* of a *caturyuga*, we call *partial*, for the purpose of simplifying the terminology.

Universal *adhimâsa* months.

The year has twelve solar months, and likewise twelve lunar months. The lunar year is complete with twelve months, whilst the solar year, in consequence of the difference of the two year kinds, has, with the addition of the *adhimâsa*, thirteen months. Now evidently the difference between the universal solar and lunar months is represented by these supernumerary months, by which a single year is extended to thirteen months. These, therefore, are the *universal adhimâsa* months.

The *universal* solar months of a *kalpa* are 51,840,000,000; the *universal* lunar months of a *kalpa* are 53,433,300,000. The difference between them or the *adhimâsa* months is 1,593,300,000.

Multiplying each of these numbers by 30, we get days, viz. solar days of a *kalpa*, 1,555,200,000,000; lunar days, 1,602,999,000,000; the days of the *adhimâsa* months, 47,799,000,000.

In order to reduce these numbers to smaller ones we divide them by a common divisor, viz. 9,000,000. Thus we get as the sum of the days of the solar months 172,800; as the sum of the days of the lunar months, 178,111; and as the sum of the days of the *adhimâsa* months, 5311.

How many solar, lunar, and civil days are required for the formation of an adhimâsa month.

If we further divide the *universal solar*, *civil*, and *lunar* days of a *kalpa*, each kind of them separately, by the *universal adhimâsa* months, the quotient represents the number of days within which a whole *adhimâsa* month sums up, viz. in $976\frac{464}{5311}$ solar days, in $1006\frac{464}{5311}$ lunar days, and in $990\frac{3663}{10622}$ civil days.

This whole computation rests on the measures which Brahmagupta adopts regarding a *kalpa* and the star-cycles in a *kalpa*.

The computation of adhimâsa according to Pulisa. Page 115.

According to the theory of Pulisa regarding the *caturyuga*, a *caturyuga* has 51,840,000 solar months, 53,433,336 lunar months, 1,593,336 *adhimâsa* months. Accordingly a *caturyuga* has 1,555,200,000 solar days, 1,603,000,080 lunar days, 47,800,080 days of *adhimâsa* months.

If we reduce the numbers of the months by the common divisor of 24, we get 2,160,000 solar months, 2,226,389 lunar months, 66,389 *adhimâsa* months. If we divide the numbers of the day by the common divisor of 720, we get 2,160,000 solar days, 2,226,389 lunar days, 66,389 days of the *adhimâsa* months. If we, lastly, divide the *universal* solar, lunar, and civil days of a *caturyuga*, each kind separately, by the universal *adhimâsa* months of a *caturyuga*, the quotient represents the numbers of days within which a whole *adhimâsa* month sums up, viz. in $976\frac{4336}{66389}$ solar days, in $1006\frac{4336}{66389}$ lunar days, and in $990\frac{21468}{66389}$ civil days.

These are the elements of the computation of the *adhimâsa*, which we have worked out for the benefit of the following investigations.

Explanation of the term *ûnarâtra*.

Regarding the cause which necessitates the *ûnarâtra*, lit. *the days of the decrease*, we have to consider the following.

If we have one year or a certain number of years, and reckon for each of them twelve months, we get the corresponding number of solar months, and by multiplying the latter by 30, the corresponding number of solar days. It is evident that the number of the lunar months or days of the same period is the same, *plus* an increase which forms one or several *adhimâsa* months. If we reduce this increase to *adhimâsa* months due to the period of time in question, according to the relation between the universal solar months and the universal *adhimâsa* months, and add this to the months or days of the years in question, the sum represents the *partial* lunar days, *i.e.* those which correspond to the given number of years.

This, however, is not what is wanted. What we want is the number of *civil* days of the given number of years which are *less* than the lunar days; for one *civil* day is greater than one *lunar* day. Therefore, in order to find that which is sought, we must subtract something from the number of lunar days, and this element which must be subtracted is called *ûnarâtra*.

The *ûnarâtra* of the *partial* lunar days stands in the same relation to the *universal* lunar days as the universal civil days are less than the universal lunar days. The universal lunar days of a *kalpa* are 1,602,999,000,000. This number is larger than the number of universal civil days by 25,082,550,000, which represents the universal *ûnarâtra*.

Both these numbers may be diminished by the common divisor of 450,000. Thus we get 3,562,220 universal lunar days, and 55,739 universal *ûnarâtra* days.

Computation of the ûnarâtra according to Pulisa.

According to Pulisa, a *caturyuga* has 1,603,000,080 lunar days, and 25,082,280 *ûnarâtra* days. The common divisor by which both numbers may be reduced is 360. Thus we get 4,452,778 lunar days and 69,673 *ûnarâtra* days.

These are the rules for the computation of the *ûnarâtra*, which we shall hereafter want for the computation of the *ahargaṇa*. The word means *sum of days*; for *âh* means *day*, and *argaṇa*, *sum*.

Criticisms on Ya'kûb Ibn Târik.

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Ya'ḳûb Ibn Ṭâriḳ has made a mistake in the computation of the solar days; for he maintains that you get them by subtracting the solar cycles of a *kalpa* from the civil days of a *kalpa*, *i.e.* the *universal* civil days. But this is not the case. We get the solar days by multiplying the solar cycles of a *kalpa* by 12, in order to reduce them to months, and the product by 30, in order to reduce them to days, or by multiplying the number of cycles by 360.

In the computation of the lunar days he has first taken the right course, multiplying the lunar months of a *kalpa* by 30, but afterwards he again falls into a mistake in the computation of the days of the *ûnarâtra*. For he maintains that you get them by subtracting the solar days from the lunar days, whilst the correct thing is to subtract the *civil* days from the lunar days.

CHAPTER LII.

ON THE CALCULATION OF "AHARGAṆA" IN GENERAL, THAT IS, THE RESOLUTION OF YEARS AND MONTHS INTO DAYS, AND, VICE VERSÂ, THE COMPOSITION OF YEARS AND MONTHS OUT OF DAYS.

General rule how to find the *sâvanâhargaṇa*.

THE general method of resolution is as follows :—The complete years are multiplied by 12; to the product are added the months which have elapsed of the current year, [and this sum is multiplied by 30;] to this product are added the days which have elapsed of the current month. The sum represents the *saurâhargaṇa, i.e.* the sum of the partial solar days.

You write down the number in two places. In the one place you multiply it by 5311, *i.e.* the number which represents the *universal adhimâsa* months. The product you divide by 172,800, *i.e.* the number which represents the *universal* solar months. The quotient you get, as far as it contains complete days, is added to the number in *the second place*, and the sum represents the *candrâhargaṇa, i.e.* the sum of the partial lunar days.

The latter number is again written down in two different places. In the one place you multiply it by 55,739, *i.e.* the number which represents the *universal ûnarâtra* days, and divide the product by 3,562,220, *i.e.* the number which represents the universal lunar days. The quotient you get, as far as it represents complete days, is subtracted from the number written in the second place, and the remainder is the *sâvanâhargaṇa, i.e.* the sum of *civil* days which we wanted to find.

Here detailed rule for the same purpose.

However, the reader must know that this computation applies to dates in which there are only complete *adhimâsa* and *ûnarâtra* days, without any fraction. If, therefore, a given number of years commences with the beginning of a *kalpa*, or a *caturyuga*, or a *kaliyuga*, this computation is correct. But if the given years begin with some other time, it may by chance happen that this computation is correct, but possibly, too, it may result in proving the existence of *adhimâsa* time, and in that case the computation would not be correct. Also the reverse of these two eventualities may take place. However, if it is known with what particular moment in the *kalpa*, *caturyuga*, or *kaliyuga* a given number of years commences, we use a special method of computation, which we shall hereafter illustrate by some examples.

The latter method carried out for Śakakâla 953.

We shall carry out this method for the beginning of the Indian year Śakakâla 953, the same year which we use as the gauge-year in all these computations.

First we compute the time from the beginning of the life of Brahman, according to the rules of Brahmagupta. We have already mentioned that 6068 *kalpas* have elapsed before the present one. Multiplying this by the well-known number of the days of a *kalpa* (1,577,916,450,000 civil days, *vide* i. p. 368), we get 9,574,797,018,600,000 as the sum of the days of 6068 *kalpas*.

Dividing this number by 7, we get 5 as a remainder, and reckoning five days backwards from the Saturday which is the last day of the preceding *kalpa*, we get Tuesday as the first day of the life of Brahman.

We have already mentioned the sum of the days of a *caturyuga* (1,577,916,450 days, v. i. p. 370), and have explained that a *kritayuga* is equal to four-tenths of it, *i.e.* 631,166,580 days. A *manvantara* has seventy-one
Page 217. times as much, *i.e.* 112,032,067,950 days. The days of

six *manvantaras* and their *saṁdhi*, consisting of seven *kṛitayuga*, are 676,610,573,760. If we divide this number by 7, we get a remainder of 2. Therefore the six *manvantaras* end with a Monday, and the seventh begins with a Tuesday.

Of the seventh *manvantara* there have already elapsed twenty-seven *caturyugas*, *i.e.* 42,603,744,150 days. If we divide this number by 7, we get a remainder of 2. Therefore the twenty-eighth *caturyuga* begins with a Thursday.

The days of the *yugas* which have elapsed of the present *caturyuga* are 1,420,124,805. The division by 7 gives the remainder 1. Therefore the *kaliyuga* begins with a Friday.

Now, returning to our gauge-year, we remark that the years which have elapsed of the *kalpa* up to that year are 1,972,948,132. Multiplying them by 12, we get as the number of their months 23,675,377,584. In the date which we have adopted as gauge-year there is no month, but only complete years; therefore we have nothing to add to this number.

By multiplying this number by 30 we get days, viz. 710,261,327,520. As there are no days in the normal date, we have no days to add to this number. If, therefore, we had multiplied the number of years by 360, we should have got the same result, viz. the *partial* solar days.

Multiply this number by 5311 and divide the product by 172,800. The quotient is the number of the *adhimâsa* days, viz. 21,829,849,018$\frac{103}{120}$. If, in multiplying and dividing, we had used the months, we should have found the *adhimâsa* months, and, multiplied by 30, they would be equal to the here-mentioned number of *adhimâsa* days.

If we further add the *adhimâsa* days to the *partial* solar days, we get the sum of 732,091,176,538, *i.e.* the *partial* lunar days. Multiplying them by 55,739, and dividing the product by 3,562,220, we get the *partial ûnarâtra* days, viz., 11,455,224,575$\frac{1,747,641}{1,781,110}$.

This sum of days without the fraction is subtracted from the *partial* lunar days, and the remainder, 720,635,951,963, represents the number of the *civil* days of our gauge-date.

Dividing it by 7, we get as remainder 4, which means that the last of these days is a Wednesday. Therefore the Indian year commences with a Thursday.

If we further want to find the *adhimâsa* time, we divide the *adhimâsa* days by 30, and the quotient is the number of the *adhimâsas* which have elapsed, viz. 727,661,633, *plus* a remainder of 28 days, 51 minutes, 30 seconds, for the current year. This is the time which has already elapsed of the *adhimâsa* month of the current year. To become a complete month, it only wants 1 day, 8 minutes, 30 seconds more.

The same calculation applied to a caturyuga according to the theory of Pulisa.

We have here used the solar and lunar days, the *adhimâsa* and *ûnarâtra* days, to find a certain past portion of a *kalpa*. We shall now do the same to find the past portion of a *caturyuga*, and we may use the same elements for the computation of a *caturyuga* which we have used for that of a *kalpa*, for both methods lead to the same result, as long as we adhere to one and the same theory (*e.g.* that of Brahmagupta), and do not mix up different chronological systems, and as long as each *guṇakâra* and its *bhâgabhâra*, which we here mention together, correspond to each other in the two computations.

The former term means a *multiplicator* in all kinds of calculations. In our (Arabic) astronomical handbooks, as well as those of the Persians, the word occurs in the form *guncâr*. The second term means each *divisor*. It occurs in the astronomical handbooks in the form *bahcâr*.

It would be useless if we were to exemplify this computation on a *caturyuga* according to the theory of Brahmagupta, as according to him a *caturyuga* is simply one-thousandth of a *kalpa*. We should only have to shorten the above-mentioned numbers by three ciphers, and in every other respect get the same results. Therefore we shall now give this computation according to the theory of Pulisa, which, though applying to the *caturyuga*, is similar to the method of computation used for a *kalpa*. Page 218.

According to Pulisa, in the moment of the beginning of the gauge-year, there have elapsed of the years of the *caturyuga* 3,244,132, which are equal to 1,167,887,520 solar days. If we multiply the number of months which corresponds to this number of days with the number of the *adhimâsa* months of a *caturyuga* or a corresponding multiplicator, and divide the product by the number of the solar months of a *caturyuga*, or a corresponding divisor, we get as the number of *adhimâsa* months $1,196,525\frac{44837}{45000}$.

Further, the past 3,244,132 years of the *caturyuga* are 1,203,783,270 lunar days. Multiplying them by the number of the *ûnarâtra* days of a *caturyuga*, and dividing the product by the lunar days of a *caturyuga*, we get as the number of *ûnarâtra* days $18,835,700\frac{598,056}{1,225,385}$. Accordingly, the *civil* days which have elapsed since the beginning of the *caturyuga* are 1,184,947,570, and this it was which we wanted to find.

A similar method of computation taken from the *Pulisa-siddhânta*.

We shall here communicate a passage from the *Pulisa-siddhânta*, describing a similar method of computation, for the purpose of rendering the whole subject clearer to the mind of the reader, and fixing it there more thoroughly. Pulisa says: "We first mark the *kalpas* which have elapsed of the life of Brahman before the present *kalpa*, *i.e.* 6068. We multiply this number by the number of the *caturyugas* of a *kalpa*, *i.e.* 1008. Thus we get the product 6,116,544. This number we multiply by the number of the *yugas* of a *caturyuga*, *i.e.* 4, and get the product 24,466,176. This number we multiply by the number of years of a *yuga*, *i.e.* 1,080,000, and get the product 26,423,470,080,000. These are the years which have elapsed before the present *kalpa*.

We further multiply the latter number by 12, so as to get months, viz. 317,081,640,960,000. We write down this number in two different places.

In the one place, we multiply it by the number of the *adhimâsa* months of a *caturyuga, i.e.* 1,593,336, or a corresponding number which has been mentioned in the preceding, and we divide the product by the number of the solar months of a *caturyuga, i.e.* 51,840,000. The quotient is the number of *adhimâsa* months, viz. 9,745,709,750,784.

This number we add to the number written in the second place, and get the sum of 326,827,350,710,784. Multiplying this number by 30, we get the product 9,804,820,521,323,520, viz. lunar days.

This number is again written down in two different places. In the one place we multiply it by the *ûnarâtra* of a *caturyuga, i.e.* the difference between civil and lunar days, and divide the product by the lunar days of a *caturyuga*. Thus we get as quotient 153,416,869,240,320, *i.e.* *ûnarâtra* days.

We subtract this number from that one written in the second place, and we get as remainder 9,651,403,652,083,200, *i.e.* the days which have elapsed of the life of Brahman before the present *kalpa*, or the days of 6068 *kalpas*, each *kalpa* having 1,590,541,142,400 days. Dividing this sum of days by 7, we get no remainder. This period of time ends with a Saturday, and the present *kalpa* commences with a *Sunday*. This shows that the beginning of the life of Brahman too was a Sunday.

Of the current *kalpa* there have elapsed six *manvantaras*, each of 72 *caturyugas*, and each *caturyuga* of 4,320,000 years. Therefore six *manvantaras* have 1,866,240,000 years. This number we compute in the Page 219.

same way as we have done in the preceding example. Thereby we find as the number of days of six complete *manvantaras*, 681,660,489,600. Dividing this number by 7, we get as remainder 6. Therefore the elapsed *manvantaras* end with a Friday, and the seventh *manvantara* begins with a *Saturday*.

Of the current *manvantara* there have elapsed 27 *caturyugas*, which, according to the preceding method of computation, represent the number of 42,603,780,600 days. The twenty-seventh *caturyuga* ends with a *Monday*, and the twenty-eighth begins with a Tuesday.

Of the current *caturyuga* there have elapsed three *yugas*, or 3,240,000 years. These represent, according to the preceding method of computation, the number of 1,183,438,350 days. Therefore these three *yugas* end with a Thursday, and *kaliyuga* commences with a Friday.

Accordingly, the sum of days which have elapsed of the *kalpa* is 725,447,708,550, and the sum of days which have elapsed between the beginning of the life of Brahman and the beginning of the present *kaliyuga* is 9,652,129,099,791,750.

The method of *ahargaṇa* employed by Âryabhaṭa.

To judge from the quotations from Âryabhaṭa, as we have not seen a book of his, he seems to reckon in the following manner:—

The sum of days of a *caturyuga* is 1,577,917,500. The time between the beginning of the *kalpa* and the beginning of the *kaliyuga* is 725,447,570,625 days. The time between the beginning of the *kalpa* and our gauge-date is 725,449,079,845. The number of days which have elapsed of the life of Brahman before the present *kalpa* is 9,651,401,817,120,000.

This is the correct method for the resolution of years into days, and all other measures of time are to be treated in accordance with this.

We have already pointed out (on p. 26) a mistake

The ahargaṇas as given by Ya'kûb Ibn Târik.

of Ya'kûb Ibn Târik in the calculation of the universal solar and *ûnarâtra* days. As he translated from the Indian language a calculation the reasons of which he did not understand, it would have been his duty to examine it, and to check the various numbers of it one by the other. He mentions in his book also the method of *ahargaṇa, i.e.* the resolution of years, but his description is not correct; for he says:—

"Multiply the months of the given number of years by the number of the *adhimâsa* months which have elapsed up to the time in question, according to the well-known rules of *adhimâsa.* Divide the product by the solar months. The quotient is the number of complete *adhimâsa* months *plus* its fractions which have elapsed up to the date in question."

The mistake is here so evident that even a copyist would notice it; how much more a mathematician who makes a computation according to this method; for he multiplies by the *partial adhimâsa* instead of the *universal.*

A second method given by Ya'kûb.

Besides, Ya'kûb mentions in his book another and perfectly correct method of resolution, which is this: "When you have found the number of months of the years, multiply them by the number of the lunar months, and divide the product by the solar months. The quotient is the number of *adhimâsa* months together with the number of the months of the years in question.

"This number you multiply by 30, and you add to the product the days which have elapsed of the current month. The sum represents the lunar days.

"If, instead of this, the first number of months were multiplied by 30, and the past portion of the month were added to the product, the sum would represent the partial solar days; and if this number were further computed according to the preceding method, we should get the *adhimâsa* days together with the solar days."

Explication of the last-mentioned method.

The rationale of this calculation is the following:—If we multiply, as we have done, by the number of the universal *adhimâsa* months, and divide the product by the universal solar months, the quotient represents the portion of *adhimâsa* time by which we have multiplied. As, now, the lunar months are the sum of solar and *adhimâsa* months, we multiply by them (the lunar months) and the division remains the same. The quotient is the sum of that number which is multiplied and that one which is sought for, *i.e.* the lunar days.

Page 220.

We have already mentioned in the preceding part that by multiplying the lunar days by the universal *ûnarâtra* days, and by dividing the product by the universal lunar days, we get the portion of *ûnarâtra* days which belongs to the number of lunar days in question. However, the *civil* days in a *kalpa* are less than the lunar days by the amount of the *ûnarâtra* days. Now the lunar days we have stand in the same relation to the lunar days *minus* their due portion of *ûnarâtra* days as the whole number of lunar days (of a *kalpa*) to the whole number of lunar days (of a *kalpa*) *minus* the complete number of *ûnarâtra* days (of a *kalpa*); and the latter number are the *universal civil* days. If we, therefore, multiply the number of lunar days we have by the universal civil days, and divide the product by the universal lunar days, we get as quotient the number of civil days of the date in question, and that it was which we wanted to find. Instead of multiplying by the whole sum of civil days (of a *kalpa*), we multiply by 3,506,481, and instead of dividing by the whole number of lunar days (of a *kalpa*), we divide by 3,562,220.

Another method of *ahargaṇa* of the Hindus.

The Hindus have still another method of calculation. It is the following:—"They multiply the elapsed years of the *kalpa* by 12, and add to the product the complete months which have elapsed of the current year. The sum they write down above the number 69,120,

(*Lacuna.*)

and the number they get is subtracted from the number written down in the middle place. The double of the remainder they divide by 65. Then the quotient represents the partial *adhimâsa* months. This number they add to that one which is written down in the uppermost place. They multiply the sum by 30, and add to the product the days which have elapsed of the current month. The sum represents the partial solar days. This number is written down in two different places, one under the other. They multiply the lower number by 11, and write the product under it. Then they divide it by 403,963, and add the quotient to the middle number. They divide the sum by 703, and the quotient represents the partial *ûnarâtra* days. This number they subtract from the number written in the uppermost place, and the remainder is the number of civil days which we want to find."

Explication of the latter method.

The rationale of this computation is the following:—If we divide the universal solar months by the universal *adhimâsa* months, we get as the measure of one *adhimâsa* month $32\frac{8544}{15933}$ solar months. The double of this is $65\frac{1155}{15933}$ solar months. If we divide by this number the double of the months of the given years, the quotient is the number of the partial *adhimâsas*. However, if we divide by wholes *plus* a fraction, and want to subtract from the number which is divided a certain portion, the remainder being divided by the wholes only, and the two subtracted portions being equal portions of the wholes to which they belong, the whole divisor stands in the same relation to its fraction as the divided number to the subtracted portion.

The latter method applied to the gauge-year.

If we make this computation for our gauge-year, we get the fraction of $\frac{1155}{1,036,800}$, and dividing both numbers by 15, we get $\frac{77}{69120}$.

It would also be possible here to reckon by single *adhimâsas* instead of double ones, and in that case it would not be necessary to double the remainder. But the inventor of this method seems to have preferred the reduplication in order to get smaller numbers; for if we reckon with single *adhimâsas*, we get the fraction of $\frac{8544}{518400}$, which may be reduced by 96 as a common divisor. Thereby we get 89 as the multiplicator, and 5400 as the divisor. In this the inventor of the method has shown his sagacity, for the reason for his computation is the intention of getting partial lunar days and smaller multiplicators.

Method for the computation of the ûnarâtra days according to Brahmagupta. Page 221.

His method (*i.e.* Brahmagupta's) for the computation of the *ûnarâtra* days is the following:—

If we divide the universal lunar days by the universal *ûnarâtra* days, we get as quotient 63 and a fraction, which may be reduced by the common divisor 450,000. Thus we get $63\frac{50,663}{55,739}$ lunar days as the period of time within which one *ûnarâtra* day sums up. If we change this fraction into eleventh parts, we get $\frac{9}{11}$ and a remainder of $\frac{55,642}{55,739}$, which, if expressed in minutes, is equal to 0′ 59″ 54‴.

Since this fraction is very near to one whole, people have neglected it, and use, in a rough way, $\frac{10}{11}$ instead. Therefore, according to the Hindus, one *ûnarâtra* day sums up in $63\frac{10}{11}$ or $\frac{703}{11}$ lunar days.

If we now multiply the number of *ûnarâtra* days, which corresponds to the number of lunar days by $63\frac{50,663}{55,739}$, the product is less than that which we get by multiplying by $63\frac{10}{11}$. If we, therefore, want to divide the lunar days by $\frac{703}{11}$, on the supposition that the quotient is equal to the first number, a certain portion must be added to the lunar days, and this portion he (the author of *Pulisa-Siddhânta*) had not computed accurately, but only approximatively. For if we multiply the universal *ûnarâtra* days by 703, we get the product 17,633,032,650,000, which is more than eleven times the universal lunar days. And if we multiply the universal lunar days by 11, we get the product 17,632,989,000,000.

The difference between the two numbers is 43,650,000. If we divide by this number the product of eleven times the universal lunar days, we get as quotient 403,963.

Criticisms of this method.

This is the number used by the inventor of the method. If there were not a small remainder beyond the last-mentioned quotient (403,963 + a fraction), his method would be perfectly correct. However, there remains a fraction of $\frac{408}{4365}$ or $\frac{9}{97}$, and this is the amount which is neglected. If he uses this divisor without the fraction, and divides by it the product of eleven times the partial lunar days, the quotient would be by so much larger as the dividendum has increased. The other details of the calculation do not require comment.

Method for finding the *adhimâsa* for the years of a *kalpa*, *caturyuga*, or *kaliyuga*.

Because the majority of the Hindus, in reckoning their years, require the *adhimâsa*, they give the preference to this method, and are particularly painstaking in describing the methods for the computation of the *adhimâsa*, disregarding the methods for the computation of the *ûnarâtra* days and the *sum of the days* (*ahargaṇa*). One of their methods of finding the *adhimâsa* for the years of a *kalpa* or *caturyuga* or *kaliyuga* is this:—

They write down the years in three different places. They multiply the upper number by 10, the middle by 2481, and the lower by 7739. Then they divide the middle and lower numbers by 9600, and the quotients are days for the middle number and *avama* for the lower number.

The sum of these two quotients is added to the number in the upper place. The sum represents the number of the complete *adhimâsa* days which have elapsed, and the sum of that which remains in the other two places is the fraction of the current *adhimâsa*. Dividing the days by 30, they get months.

Ya'ḳûb Ibn Ṭâriḳ states this method quite correctly. We shall, as an example, carry out this computation for our gauge-year. The years of the *kalpa* which have elapsed

P. 206.—*Kavîtal* = *Kapisthala* = *Καμβισθόλοι* (Megasthenes), now *Kapoorthala*, G. Smith, p. 208. *Vide* also *Kaithal* in Elliot's "History of India," ii. 337, 353.

Mandahûkûr. *Cf.* Elliot, *l. c.* i. 530.

P. 206. *Kusnarî.*—I am inclined to identify this river with the *Kunhar* (G. Smith, p. 231). Is the Mahvî = Kishen-Ganga?

P. 207.—*Ûshkârâ* is explained by Cunningham, *l. c.* p. 99, as Hushkapura, Huvishkapura and Barâmûla as *Vardhamûla.*

P. 208.—*Tâkeshar* is perhaps to be explained as *Ṭakkatêśvara*, like Bhoteshar = Bhaṭṭa-îśvara. *Cf.* on *Ṭakka*, Cunningham, *l. c.* p. 749.

Râjavarî seems to be identical with Rajaori (G. Smith, p. 228).

P. 208. *The coast of India begins with Tîz.*—*Cf.* with this route along the coast that one given by Ibn Khurdâdbih in Elliot, "History of India," i. 15, 16; A. Sprenger, *Die Post- und Reiserouten des Orients*, pp. 80–82.

Munha = Skr. *mukha*, Prakrit *muhaṁ*, Hindî *muṅh*: *v.* Hörnle, "Comparative Grammar," § 116.

Daibal.—On the identification with Karâci v. Elliot, "History of India," i. 375. Daibal-Sindh is the *Diulcindî* of Duarte Borbosa, translated by Stanley, p. 49 (Hakluyt Society).

Pp. 208, 209.—*Barot* = Baroda, *Kanbâyat* = Kambay, *Bihroj* = Broach. *Sûbâra* is identical with Skr. *Śûrpâraka*, Ptolemy's *Σούπαρα*, and the *Sufâla* of the Arabs. *Tâna* = Skr. *sthâna*, and *Sandân* is perhaps = *saṁdhâna.* To Sûbâra, *cf.* Bhagvánlál Indraji, "Antiquarian Remains of Sopara," &c., "Journal" of the Bombay branch, 1881, 1882, vol. xv. p. 273.

P. 209.—*Panjayâvar* seems to be a mistake for some older form of the name *Tanjore.*

Râmsher = *Râmeśvara*?—On Râma and the monkeys of the Kishkindha mountains *cf.* the fourth book of the *Râmâyaṇa.*

P. 210.—The theory of the rising and disappearing of the Dîva islands seems to have been a favourite one of the author's, for he explains it in three different places; *v.* p. 233, and ii. 106.

P. 211.—*Shauḥaṭ* is explained by Johnson as a tree whence bows are made, and *mulamma'* means *having different colours.* What particular sort of wood this means I do not know.

P. 211.—*Indravedi* must be changed into *Antarvedi,* "the old name of the Lower Doáb, extending from about Etawah to Allahabad." Elliot-Beames, "Memoirs," ii. 10; Elliot, "History of India," ii. 124.

Is *Bhâtal* identical with Ptolemy's *Παταληνή*?

P. 213. *We have already mentioned,* viz. on p. 17.

P. 214. *ὧραι καιρικαί, i.e.* the ancient division of day and night, each in twelve equal parts, of whatsoever length day and night happened to be. These hours were different in the different seasons of the year. On the contrary, the *ὧραι ἰσημεριναί,* probably of scientific origin, are the twenty-fourth part of a nychthemeron, always equal throughout the course of the whole year. *Cf.* Ideler, *Handbuch der Chronologie,* i. 86.

P. 214. *Horâ.*—The Persian *nîmbahra* means *half part,* and in astrology one-half or fifteen degrees of a sign of the zodiac; *v.* ii. 222.

P. 214, l. 30.—The distance between the sun and the degree of the ascendens divided by fifteen gives in hours the time which has passed since sunrise; the dominus of the day being at once the dominus of the first hour, the rule here given is evidently correct (*Schram*).

P. 215.—For names of planets *v.* E. Burgess, *Sûrya Siddhânta,* pp. 422, 423, and A. Weber, *Indische Studien,* ii. 261.

Instead of آنتير read آونير, *âvaneya.* The word *bibatâ* is probably some form of *vivasvant.*

The reader will notice the Greek names *heli* ἥλιος, *âra*

Ἄρης, hemna Ἑρμης, jîva Ζεύς, âsphujit Ἀφροδίτη, koṇa **Κρόνος.**

Pp. 216, 217, 218. *Vishṇudharma.—Vide* note to p. 54.

P. 217. *Table.*—I shall here give the names of the months as the author probably pronounced them, but cannot be held responsible for the details of the vowel-pronunciation: *cetr, bêshâk, jert, âshâr, shrâban, bhadro, âshûj, kârtik, manghir, posh, mâg, pâgun.* Perhaps most of these names terminated in short *u*, as *manghiru. Cf.* the Hindustani names in Dowson's "Grammar of the Urdû," 1887, p. 259.

The *vernacular* names of the suns are perhaps to be pronounced: *rabi, bishnu, dhâta, bidhâta, arjamu, bhagu, sabita, pûsha, tvashta, arku, dibâkaru, anshu.*

The difference between vernacular and classical speech is repeatedly referred to. *Vide* i. 18 (*v.* note), 218.

P. 218. *With the tradition of the Vishṇudharma.*—After these words must be added the following, which I have overlooked in translating: "And further he (*i.e.* Vâsudeva) has spoken in the *Gîtâ*, '*I am like the vasanta, i.e.* the equinox, *among the six parts of the year.*' This too proves that the tradition as given in the first table is correct." Cf. *Bhagavad-Gîtâ*, x. 35.

P. 218.—Compare the table of the *nakshatras* with E. Burgess, *Sûrya Siddhânta*, p. 468.

P. 219.—*Varâhamihira.—Vide* note to p. 54.

P. 220.—The Greek names *kriya κριός, tâmbiru ταῦρος, jituma δίδυμοι, pârtîna παρθένος*, &c., are declared to be not generally known. *Cf.* A. Weber, *Indische Studien*, ii. 259. Instead of *jîtu* read *cetthu.*

P. 222. *Galenus.*—I have not been able to verify this quotation about Asclepius in the Greek works of Galenus.

P. 223. *From the belief of the nations who lived in ancient times in and round Babel, &c.*—That information to which the author here refers was probably derived from the books of the Manichæans.

P. 223. *Plato.*—This quotation is not identical with *Timæus* 36 B–D, but apparently derived therefrom. It runs :—

ταύτην οὖν τὴν ξύστασιν πᾶσαν διπλῆν κατὰ μῆκος σχίσας μέσην πρὸς μέσην, κ.τ.λ. τὴν δ' ἐντὸς σχίσας ἑξαχῇ ἑπτὰ κύκλους ἀνίσους, κ.τ.λ.

Cf. note to p. 35.

Pp. 223, 224.—On *Brahmagupta* and *Pulisa, v.* notes to pp. 153, 154.

P. 225. *Vasishtha, Âryabhaṭa.*—The author does not take the theories of these men from their own works; he only knew them by the quotations in the works of Brahmagupta. He himself states so expressly with regard to Âryabhaṭa. *Cf.* note to p. 156, and the author, i. 370.

P. 225, 227. *Balabhadra.*—*Vide* note to p. 156.

P. 226. *Aristotle. Cf.* his *Phys.* vii. 1, and *Metaph.* xii. 8, 24.

P. 226. *Ptolemy.*—*Cf.* the edition of Halma, Paris, 1813, tome i. p. 2:

τὸ μὲν τῆς τῶν ὅλων πρώτης κινήσεως πρῶτον αἴτιον, εἴ τις κατὰ τὸ ἁπλοῦν ἐκλαμβάνοι, θεὸν ἀόρατον καὶ ἀκίνητον ἂν ἡγήσαιτο, καὶ τὸ τούτου ζητητέον εἶδος θεολογικὸν, ἄνω που περι τὰ μετεωρότατα τοῦ κόσμου τῆς τοιαύτης ἐνεργείας νοηθείσης ἂν μόνον, καὶ καθάπαξ κεχωρισμένης τῶν αἰσθητῶν οὐσίων.

P. 226. *Johannes Grammaticus.*—*Vide* note to p. 36. I have not been able to find this quotation in the Greek text.

Pp. 228, 229.—The author repeatedly complains of the great verbosity of the Sanskrit caused by the necessities of the authors, who will only write in metre, and require a great number of synonyms, in order that one word may fit into the metre if others will not. *Cf.* i. 213, 217, 299.

P. 229. *For those men who, &c.*—This is the only passage in which Alberuni clearly speaks of his Pandits. Apparently he tried hard to learn Sanskrit, but could not succeed on account of the difficulties of which he himself complains, and he studied Indian literature in the same manner as the first English scholars in Bengal, by the help of native Pandits.

P. 230. Table.—*Cf. Vishṇu-Purâṇa*, ii. 209, where the fifth and seventh earths are called *mahâtala* and *pâtâla*.

Also the *Vâyu-Purâṇa* (ed. Rajendralâlâ Mitra, Calcutta, 1880) offers somewhat different names, viz. *atalam*, *sutalam*, *vitalam*, *gabhastalam*, *mahâtalam*, *śrîtalam*, *pâtâlam*, and *kṛishṇa-bhaumam*, *pâṇḍu*, *raktam*, *pîta*, *śarkara*, *śilâmayam*, *sauvarṇa* (vol. i. p. 391, v. 11–14).

P. 231. *The spiritual beings, &c.*—This list of names is literally taken from *Vâyu-Purâṇa*, vol. i. p. 391, v. 15–394, v. 43 (*Adhyâya*, 50).

P. 231. *Johannes Grammaticus.*—I have not been able to find this quotation in the Greek text, nor the verse of Homer. *Vide* note to p. 36.

P. 231. *Plato.*—Cf. *Timæus*, 41A:—

Θεοὶ θεῶν ὧν ἐγὼ δημιουργὸς πατήρ τε ἔργων, ἃ δι' ἐμοῦ γενόμενα ἄλυτα ἐμοῦ γ' ἐθέλοντος· τὸ μὲν οὖν δὴ δεθὲν πᾶν λυτόν, τό γε μὴν καλῶς ἁρμοσθὲν καὶ ἔχον εὖ λύειν ἐθέλειν κακοῦ.

P. 232. *Vishṇu-Purâṇa.*—The seven lokas. *Vide* ii. 226, 227.

P. 232. *The commentator of the book of Patañjali.*—*Cf.* note to p. 27.

P. 233. *Dîbajât.*—This remark was already made on p. 210.

P. 235. *Vishṇu-Purâṇa.—Vide* the *dvîpas* and seas, *Vishṇu-Purâṇa*, ii. 109.

P. 236. *Lokâloka*, which means a *not-gathering place*. Apparently the author had not quite understood the nature of the compound *loka-aloka*, i.e. *world and not-world.*

P. 237. *Vishṇu-Purâṇa.*—The first quotation seems to correspond to ii. 211–213, the second to ii. 204, and the third (on p. 238) to ii. 225–227.

Śeshâkhya is apparently a mistake for *Śesha-âkhya*, i.e. *having the name of Śesha.*

P. 240.—The story of Viśvâmitra's attempt at creating a second world is taken from *Râmâyaṇa*, i. chaps. lvii.–lx.; but here the king is called *Triśaṅku.*

P. 240.—On *Śrîpâla*, *v.* note to p. 164. The city of Multân is in various places mentioned by the author in such a remarkable manner as makes me think that he knew it, and that he had lived there for some time. When King Maḥmûd, A.H. 408 (A.D. 1017), had returned from Khwârizm-Khîva after the conquest of the country, and had carried along with him the princes of the conquered house of Ma'mûn, many scholars (among them Alberuni), officers, and soldiers, did he send some of these (among them Alberuni) as state prisoners to Multân, which he had conquered years before? In this way, nineteen years later (A.H. 427), the princes of the family of Altuntash, who had ruled Khwârizm after the Ma'mûnîs, were treated by Maḥmûd's grandson, Majdûd, who sent them as state prisoners to Lahore. At all events, it is perfectly certain that Alberuni cannot have been in favour with King Maḥmûd, or he would have dedicated one of his books to him. *Cf.* Sachau, *Zur ältesten Geschichte und Chronologie von Khwârizm*, i. pp. 16, 28.

P. 240.—*Aljaihânî* is one of the fathers of Muslim literature on geography and travels in the eastern part of the Khaliphate, minister of one of the Sâmânî kings of Central Asia towards the end of the ninth Christian century. His work is most extensively quoted, but has not yet come to light. *Cf.* Aloys Sprenger, *Die Post- und Reiserouten des Orients*, Vorrede, p. xvii.

P. 241. *When Brahman wanted, &c.*—On the division of Brahman, on Dhruva, &c., *cf.* *Vishṇu-Purâṇa*, i. pp. 104, 161 *seq.*

P. 242. 1020 *to* 1030 *stars.*—This is the number of stars enumerated in the star-catalogue of 'Abdurraḥmân Ṣûfî (*cf.* Schjellerup, *Description des Étoiles fixes par Alṣûfî*, St. Petersburg, 1874), which Alberuni has transferred into his *Canon Masudicus.*

Should those men breathe and receive, &c.—I am not quite certain whether I have found out the right meaning of these words or not.

P. 243. *The commentator Balabhadra, &c.*—*Vide* note to p. 156.

P. 245, l. 10.—The values here given correspond to the greatest declination of 24°. So AT = 1397′ is the sine of 24°, BT = 298′ the versed sine of 24°, and TH the difference between this latter and the radius 3438′ (*Schram*).

P. 245, l. 12. *Kardajât.*—The word *kardaja* seems to be derived from the Persian *karda = cut*, meaning a *segment.* The radius is equal to 3438 minutes of the periphery, which are called *kardajât.* *Cf.* i. 275, and ii. 205.

P. 246, 1.—Read 24° instead of 23°.

P. 246. *Âryabhaṭa of Kusumapura* is repeatedly quoted by Alberuni. He mentions the orders of the numbers from *ayutaṁ* to *parapadma*, i. 176. Here he speaks of the height of Mount Meru, on the longitude of Kurukshetra, i. 316 (where he quotes Pulisa and Pṛithusvâmin), on the day of the Devas and that of the Pitaras, i. 330. He calls the *cashaka vinâḍî*, i. 335. From a book of his it is quoted that 1008 *caturyugas* are one day of Brahman; half of it is *utsarpiṇî*, the other half *avasarpiṇî* (Jaina terms), i. 371. Unfortunately I cannot read the title of this book; the signs may be النتف, and it must remain uncertain whether it is an Arabic word with the article or an Indian one.

Alberuni warns the reader not to confound this Âryabhaṭa with the elder scholar of this name, to whose followers he belongs. In this place (i. 246) Alberuni does not seem to have used a work of Âryabhaṭa *junior* himself, but to have taken these words of his from a commentary of Balabhadra. We learn here that the book had been translated into Arabic, but do not learn which particular work of Balabhadra's. Was it his commentary on the *Khaṇḍakhâdyaka* of Brahmagupta? *Vide* note to p. 156. That Alberuni had made a new edition of the Arabic version of the *Khaṇḍakhâdyaka* is known (*v.* edition of the Arabic original, pref. p. xx.); perhaps he had also procured himself an Arabic translation of Balabhadra's commentary. *Cf.* on this younger Âryabhaṭa, Kern, *Bṛhat Sañhitâ*, preface, pp. 59, 60, and Dr. Bhâu Dâjî, "Brief Notes on the Age and Authenticity of the Works of Âryabhaṭa, Varâhamihira," &c., p. 392. Alberuni always calls him Âryabhaṭa of Kusumapura (Patna), to distinguish him from his elder namesake.

P. 247. *Śuktibâm.*—This seems to be some vernacular form for *Śuktimat. Vishṇu-Purâṇa*, ii. 127. Rikshabâm =*Ṛikshavat* (?).

P. 248. *The Vishṇu-Purâṇa says.*—I do not find this quotation in the *Vishṇu-Purâṇa*. *Cf. V. P.* ii. 117.

P. 248. *The commentator of the book of Patañjali.*—*Vide* note to p. 27.

P. 249. *Alerânshahrî.*—*Vide* note to pp. 6, 7.

P. 249. *Ardiyâ* and Girnagar (?) are apparently the same mountains which the Avesta calls *hara berezaiti* and *taera*.

P. 254. *Vishṇu-Purâṇa.*—The quotations from the *V. P.* given in this chapter are found in ii. p. 191 *seq.*

P. 254.—*Jaunu*, as here the river Yamunâ is called, corresponds to the Prakrit form prescribed by Vararuci ii. 3, viz. *Jauṇâ*.

P. 257. *Vâyu-Purâṇa.*—The names of the rivers are found in the 45th *Adhyâya*, vol. i. pp. 349–350. The order of enumeration of the mountains in the Sanskrit text is this: Pâriyâtra, Ṛiksha, Vindhya, Sahya, Malaya, Mahendra, Śukti.

V. 97.

vedasmṛitir vedavatî vṛitradhnî sindhur eva ca
varṇâśâ candanâ caiva satîrâ mahatî tathâ.

V. 98.

parâ carmmaṇvatî caiva vidiśâ vetravaty api
śiprâ hy avantî ca tathâ pâriyâtrâśrayâḥ smṛitâḥ.

V. 99.

śoṇo mahânadaś caiva narmmadâ sumahâdrumâ
mandâkinî daśârṇâ ca citrakûṭâ tathaiva ca.

V. 100.

tamasâ pipyalâ śroṇî karatoyâ piśâcikâ
nîlotpalâ vipâśâ ca bañjulâ bâluvâhinî.

V. 101.

siterajâ śuktimatî makruṇâ tridivâ kramât
ṛikshapâdât prasûtâs tâ nadyo maṇinibhodakâḥ.

V. 102.

tâpî payoshṇî nirbbandhyâ madrâ ca nishadhâ nadî
venvâ vaitaraṇî caiva śitivâhuḥ kumudvatî.

V. 103.

toyâ caiva mahâgaurî durgâ câ 'ntaḥśilâ tathâ
vindhyapâdapraśûtâś ca nadyaḥ puṇyajalâḥ śubhâḥ.

V. 104.

godâvarî bhîmarathî kṛishṇâ vaiṇy atha vañjulâ
tuṅgabhadrâ suprayogâ kâuverî ca tathâ, pagâ
dakshiṇâpathanadyas tu sahyapâdâd viniḥsṛitâḥ.

V. 105.

kṛitamâlâ tâmravarṇâ pushpajâṭy utpalâvatî
malayâbhijâtâs tâ nadyaḥ sarvâḥ śîtajalâḥ śubhâḥ.

V. 106.

trisâmâ ṛitukûlyâ ca ikshulâ tridivâ ca yâ
lâṅgûlini vaṁśadharâ mahendratanayâḥ smṛitâḥ.

V. 107.

ṛishîkâ sukumârî ca mandagâ mandavâhinî
kûpâ palâśinî caiva śuktimatprabhavâḥ smṛitâḥ.

P. 259.—Very similar to this enumeration of rivers is that in the *Vâyu-Purâṇa*, adhyâya 45, vv. 94–108:—

V. 94.

pîyante yair imâ nadyo gaṅgâ sindhusarasvatî
śatadruś candrabhâgâ ca yamunâ sarayûs tathâ.

V. 95.

irâvatî vitastâ ca vipâśâ devikâ kuhûḥ
gomatî dhutapâpâ ca bâhudâ ca dṛishadvatî.

V. 96.

kauśikî ca tritîyâ tu niścîrâ gaṇḍakî tathâ
ikshu lohita ityetâ himavatpâdaniḥsṛitâḥ.

The following verse, already given in the note to p. 273, mentions the rivers flowing from the Pâriyâtra.

P. 259. *Vedasinî.*—Write *Vidâsinî.*

P. 259. *Kâyabish.*—The realm of Kâyabish is here identified with Kâbul. The signs may be read *Kâyabish* or *Kâyabshi*; only the consonants are certain. This reminds one forcibly of the name of the Indo-Scythian king *Kadaphes.* A dental sound between two vowels may in later forms be represented by a *y*, as *e.g.* in *Biyattu* = *Vitastâ.* Or is the word to be combined with Panini's *Kâpishî* (*Capissene* in Pliny)? *Cf.* Paṇini and the geography of Afghanistan and the Panjâb in "Indian Antiquary," 1872, p. 21.

P. 259. *Ghûzak.*—This pass (ʻ*akaba* in Arabic) is also mentioned in Elliot, "History of India," ii. 20, 449 (Ghûrak).

P. 259. *Below the town of Parvân.*—It is mentioned in the maps at about the distance of eight miles, as the crow flies, north of Tschârikar. The road from Anderâb to Parvân has been sketched by Sprenger, *Post- und Reiserouten*, map nr. 5.

P. 259. *The rivers Nûr and Ḳirâ.*—Read *Ḳirâṭ* instead of Ḳirâ. *Cf.* Elliot, *l. c.* ii. 465.

P. 260.—*Bhâtul* seems to mean a sub-Himalayan country between the Beas and the Satlej. It occurs only here and p. 211 (together with Antarvedi). Masudi (Elliot, "History of India," i. 22) mentions it as the name of one of the five rivers of Panjab.

The union of the seven rivers.—This tradition apparently refers to the *hapta hendu* of the Avastâ, Vendidad i. 73.

P. 261. *Matsya-Purâṇa.*—Not having this book at hand, I give the corresponding passage from the *Vâyu-Purâṇa*, adhyâya 47, vv. 38–58:—

V. 38.

nadyâḥ śrotas tu gaṅgâyâḥ pratyapadyata saptadhâ
nalinî hrâdinî caiva pâvanî caiva prâggatâ.

V. 39.

sîtâ cakshuś ca sindhuś ca pratîcîṁ diśam âśritâḥ
saptamî tv anugâ tâsâṁ dakshiṇena bhagîrathî, &c.

V. 42.

upagacchanti tâḥ sarvâ yato varshati vâsavaḥ
sirindhrân kuntalâṇs cînân varvarân yavasân druhâo.

V. 43.

rushâṇâṁś ca kuṇindâṁsca aṅgalokavarâṁś ca ye
kṛitvâ dvidhâ sindhumaruṁ sîtâ 'gât paścimodadhiṁ.

V. 44.

atha cînamarûṁś caiva naṅgaṇân sarvamûlikân
sâdhrâṁs tushârâṁs tampâkân pahlavân daradân śakân
etân janapadân cakshuḥ ṣrâvayantî gato 'dadhiṁ.

V. 45.

daradâṁś ca sakâśmîrân gândhârân varapân hradân
śivapaurân indrahâsân vadâtîṁś ca visarjayân.

V. 46.

saindhavân randhrakarakân bhramarâbhîrarohakân
śunâmukhâṁs cordhvamanûn siddhacâraṇasevitân.

V. 47.

gandharvân kinnarân yakshân rakshovidyâdharoragân
kalâpagrâmakâṁś caiva pâradân sîgaṇân khasân.

V. 48.

kirâtâṁś ca pulindâṁś ca kurûn sabharatân api
pañcâlakâśimâtsyâṁś ca magadhâṅgâṁs tathaiva ca.

V. 49.

brahmottarâṁś ca vaṅgâṁśca tâmaliptâṁs tathaiva ca
etân janapadân âryyân gaṅgâ bhâvayate śubhân.

V. 50.

tataḥ pratihatâ vindhye pravishṭâ dakshiṇodadhim
tataś câ 'hlâdinî puṇyâ prâcînâbhimukhî yayau.

V. 51.

plâvayanty upabhogâṁś ca nishâdânâñ ca jâtayaḥ
ghîvarân ṛishakâṁś caiva tathâ nîlamukhân api.

V. 52.

keralân ushṭrakarṇâṁś ca kirâtân api caiva hi
kâlodarân vivarṇâṁś ca kumârân svarṇabhûshitân.

V. 53.

sâ maṇḍale samudrasya tirobhûtâ 'nupûrvataḥ
tatas tu pâvanî caiva prâcîṁ eva diśaṅ gatâ.

V. 54.

apathân bhâvayantî 'ha indradyumnasaro pi ca
tathâ kharapathâṁś caiva indraśaṅkupathân api.

V. 55.

madhyen 'dyânamaskarân kuthaprâvaraṇân yayau
indradvîpasamudre tu pravishṭâ lavaṇodadhiṁ.

V. 56.

tataś ca nalinî câ 'gât prâcîmâśâṁ javena tu
tomarân bhâvayantî ha haṁsamârgân sahûhukân.

V. 57.

pûrvân deśâṁs ca sevantî bhittvâ sâ bahudhâ girîn
karṇaprâvaraṇâṁś caiva prâpya câ 'śvamukhân api.

V. 58.

sikatâparvatamarûn gatvâ vidyâdharân yayau
nemimaṇḍalakoshṭhe tu pravishṭâ sâ mahodadhiṁ.

P. 262. *Vishṇu-Purâṇa.*—This quotation occurs *V. P.* ii. 192. Instead of Anutapata, Shikhi, and Karma, read *Anutaptâ*, *Sikhi*, and *Kramu.*

P. 263. *Created.*—This word seems to prove that Alberuni already adhered to the dogma of orthodox Islam, that the Koran had been created by God from all eternity, and had been preserved on a table in heaven before God revealed it to mankind by the mouth of his prophet, Muḥammad.

P. 264. *Ibn Almuḳaffa'* ('Abdallâh) and *'Abdalkarîm* are also mentioned in the author's "Chronology of Ancient Nations," pp. 80 and 108.

P. 265. *For this the astronomers requite them, &c.*—When writing these criticisms, the author probably thought of Brahmagupta. *Cf.* the chapter on eclipses, ii. 110 *seq.*

P. 267. *Yamakoṭi, Laṅkâ, &c.*—*Cf.* the same names in *Sûrya-Siddhânta*, xii. 38–40.

P. 268. *Âryabhaṭa, Vasishṭha, Lâṭa.*—All the astronomers quoted in this context were not known to the author from their own works, but only through quotations in the works of Brahmagupta. Also the words of Varâhamihira (here and p. 272) seem to be quotations of Brahmagupta (evidently p. 276), although they possibly might have been taken from Varâhamihira's *Pañcasiddhântikâ*. Pulisa, of course, must be excepted, as his *Siddhânta* was in the hands of Alberuni, and in course of being translated by him.

P. 271. *Amarâvatî, Vaivasvata, &c.*—*Cf.* on these four cities *Vishṇu-Purâṇa*, ii. 240.

P. 273. *Âpta-purâṇa-kâra.*—I do not see how the Arabic signs must be read. The translation of the term means *the true ones who follow the Purâṇa.*

P. 274, l. 37.—TA being the sine of $3\frac{3}{4}^\circ$ is equal to $225'$, its square to 50,625; TB the versed sine of $3\frac{3}{4}^\circ$ is $7'$, and $HT = \text{radius} - TB = 3438' - 7 = 3431$ (*Schram*).

P. 275, l. 3.—The following calculation seems to have been made very negligently, for there are several faults in it. The radius $795^\circ\ 27'\ 16''$ is correctly determined, for employing the ratio $7 : 22$ between diameter and circumference, we are indeed led to this number. But already in the determination of BC there is a fault. Alberuni seems to have converted $0^\circ\ 7'\ 42''$ into yojanas, instead of converting $0^\circ\ 7'\ 45''$; for 360° being equivalent to 5000 yojanas, we get for 1° 13 yojana, 7 krośa, $444\frac{4}{9}$ yards, for $1'$ 1 krośa, $3407\frac{11}{27}$ yards, and for $1''$ $123\frac{37}{81}$ yards, and reckoning with those numbers we get $0^\circ\ 7'\ 42''$, and not $0^\circ\ 7'\ 45''$, which corresponds to 57,035 yards. Further, the rule he makes use of is completely erroneous; it is not true that the relation between the height of two observers is the same as the relation between the sines of their respective fields of vision. If this were the case, we should have $\sec\alpha - 1 : \sin\alpha = \sec\beta - 1 : \sin\beta$, or the quotient $\frac{\sec\alpha - 1}{\sin\alpha}$ would be a constant for every value of α, which, of course, is not the case. But even with his incorrect rule we cannot find the numbers he has found. This rule is 4 yards : sine of field of vision = 57,035 yards : $225'$, so one would have sine of field of vision $= \frac{4 \times 225'}{57035}$; but he finds the sine of the field of vision equal to $0^\circ\ 0'\ 1''\ 3'''$, which corresponds to $\frac{1000'}{57035}$, and not to $\frac{900'}{57035}$. Therefore Alberuni seems to have reckoned $4 \times 225 = 1000$ instead of 900. Also the length of each degree is not quite correct; it is not 13 yojana, 7 krośa, $333\frac{1}{3}$ yards, but, as above stated, 13 yojana, 7 krośa, $444\frac{4}{9}$ yards. Lastly, if we convert by means of this *number* $0^\circ\ 0'\ 1''\ 3'''$ into yards, we find $129\frac{5}{8}$ yards, so that the $291\frac{5}{8}$ yards he speaks of seem to have been arrived at by an erroneous metathesis of the original ciphers (*Schram*).

P. 277. *Prâṇa.*—*Cf.* on this measure of time here i. 334, 335.

P. 278. *The inhabitants of Mount Meru, &c.*, till *as a westward motion*, almost identical with *Sûrya-Siddhânta*, xii. 55.

P. 281. *There is a story of an ancient Greek, &c.*—Probably taken from Porphyry's book on the opinions of the most prominent philosophers about the nature of the sphere. *Vide* note to p. 43.

P. 289. *The Greeks determined, &c.*—The author has given a description of the winds, according to the Arabian and Persian views, in his "Chronology of Ancient Nations," pp. 340, 341.

P. 291. *Atri, Daksha, &c.*—The legends here referred to are found in *Vishṇu-Purâṇa*, i. 153, ii. 21 *seq.*

P. 294.—*The Ṛishi Bhuvana-kośa* (*i.e.* globe) is only mentioned in this place, and not known to me from other sources. His work, the title of which is not given, seems to have treated of geography.

P. 295. *Samnâra* (?).—Thus the manuscript seems to have it. The signs may also be read *Samnâd*.

P. 297. *Kûrmacakra.*—*Vide* on this term a note of H. Kern, *Bṛihat Saṁhitâ*, translation, to the title (*kûrmavibhâga*) of chap. xiv.

P. 298. *Utpala, a native of Kashmîr.*—*Vide* note to p. 157.

P. 298.—*Stone-tower, i.e.* the *Λίθινος πύργος* of Ptolemy, vi. 13, 2.

P. 299.—Bûshang, a place near Herat, to the west. Sakilkand, also Iskilkand, is identified with *Alexandria* by Elliot, "History of India," i. 366, note 1. Perhaps it is identical with *Σιγὰλ πόλις* of Stephanus. *Cf.* Droysen, *Geschichte des Hellenismus*, iii. 2, 217.

P. 299.—This extract from *Vâyu-Purâṇa* is found in *adhyâya* 45, vol. i. pp. 350–353, vv. 109–136. Alberuni gives the directions in the following order: east, south, west, north; whilst the Sanskrit text has this order: north, east, south, west. In comparing the following text with Alberuni, the *varietas lectionis* given in the footnotes of the Calcutta edition can sometimes be used with advantage.

V. 109.

kurupâñcalâḥ śâlvâś caiva sajâñgalâḥ

V. 110.

śûrasenâ bhadrakârâ bodhâḥ śatapatheśvaraiḥ
vatsâḥ kisashṭâ kulyâś ca kuntalâḥ kâśikośalâḥ.

V. 111.

atha pârśvê tilaṅgâś ca magadhâś ca vṛikaiḥ saha.

V. 115.—NORTH.

vâhlîkâ vâḍhadhânâś ca âbhîrâḥ kâlatoyakâḥ
aparîtâś ca śûdrâś ca pahlavâś carmakhaṇḍikâḥ.

V. 116.

gândhârâ yavanâś caiva sindhusauvîrabhadrakâḥ
śakâ hradâḥ kulindâś ca paritâ hârapûrikâḥ.

V. 117.

ramaṭâ raddhakaṭakâḥ kekayâ daśamânikâḥ
kshatriyopaniveśâś ca vaiśyaśûdrakulâni ca.

V. 118.

kâmbojâ daradâś caiva varvarâḥ priyalaukikâḥ
pînâś caiva tushârâś ca pahlavâ vâhyatodarâḥ.

V. 119.

âtreyâś ca bharadvâjâḥ prasthalâś ca kaserukâḥ
lampâkâ stanapâś caiva pîḍikâ juhuḍaiḥ saha.

V. 120.

apagâś câ 'limadrâś ca kirâtânâñ ca jâtayaḥ
tomârâ haṁsamârgâśca kâśmîrâs taṅgaṇâs tathâ.

V. 121.

cûlikâś câ hukâś caiva pûrṇadarvâs tathaiva ca

V. 122.—East.

andhravâkâḥ sujarakâ antargiri vahirgirâḥ
tathâ pravaṅgavaṅgeyâ mâladâ mâlavarttinaḥ.

V. 123.

brahmottarâḥ pravijayâ bhârgavâ geyamarthakâḥ
prâgjyotishâś ca muṇḍâś ca videhâs tâmaliptakâḥ
mâlâ magadhagovindâḥ.

V. 124B.—South.

pâṇḍyâś ca keralâś caiva caulyâḥ kulyâs tathaiva ca
setukâ mûshikâś caiva kumanâ vanavâsikâḥ
mahârâshṭrâ mâhishakâḥ kaliṅgâś ca.

V. 126.

abhîrâḥ saha cai 'shîkâ âṭavyâś ca varâś ca ye
pulindrâ vindhyamûlîkâ vaidarbhâ daṇḍakaiḥ saha.

V. 127.

pînikâ maunikâś caiva asmakâ bhogavarddhanâḥ
nairṇikâḥ kuntalâ audhrâ udbhidâ nalakâlikâḥ.

V. 128.

dâkshiṇâtyâś ca vaideśâ aparâṅs tân nibbodhata
śûrpâkârâḥ kolavanâ durgâḥ kalîtakaiḥ saha.

V. 129.

puleyâś ca surâlâś ca rûpasâs tâpasaiḥ saha
tathâ turasitâś caiva sarvê caiva parâksharâḥ.

V. 130.

nâsikyâ 'dyâś ca ye cânye ye caivâ 'ntaranarmadâḥ
bhânukacchrâḥ samâheyâḥ sahasâ śâśvatair api.

V. 131.

kacchîyâś ca surâshṭrâs, ca anarttâś câ 'rvudaiḥ saha.

V. 132.—WEST.

mâlavâś ca karûshâś ca mekalâśco 'tkalaiḥ saha
uttamarṇâ daśârṇâś ca bhojâḥ kishkindhakaiḥ saha.

V. 133.

tosalâḥ kosalâś caiva traipurâ vaidikâs tathâ
tumurâs tumburâś caiva shaṭsurâ nishadhaiḥ saha.

V. 134.

anupâs tuṇḍikerâś ca vîtihotrâ hy avantayaḥ.

V. 135.

nigarharâ haṁsamârgâḥ kshupaṇâs taṅgaṇâḥ khasâḥ.

V. 136.

kuśaprâvaraṇâś caiva hûṇâ darvâḥ sahûdakâḥ
trigarttâ mâlavâś caiva kirâtâs tâmasaiḥ saha.

Pp. 300–303.—This extract from Varâhamihira's *Samhitâ* is taken from chap. xiv. *Cf.* the text in Kern's edition, p. 87, the *varietas lectionis*, pp. 12–14, and his translation in "Journal of the Asiatic Society," 1870, p. 81–86. The number of discrepancies between these two traditions is very considerable. In many places Alberuni and his Pandit may not have read their manuscript with sufficient accuracy; in others, the Sanskrit manuscript-tradition may exhibit blunders arising from a not uncommon confusion of characters that are much like each other. The Arabic manuscript-tradition is on the whole correct, but the copyist of the Arabic text, too, may have contributed in some case to increase the number of errors. To some Indian names he has added explanatory glosses, *e.g. Sauvîra, i.e.* Mûltân and Jahrâvâr. It is a pity he has done this so sparingly.

P. 303.—*Ya'kûb and Alfazârî.—Vide* notes to pp. 169 and 165.

P. 304.—*Abû-Ma'shar*, author of many books, chiefly on astrology, died A.H. 272=A.D. 885. He is known to the Middle Ages in Europe as Albumaser.

P. 306. *Cupola of the earth.*—If this expression has not been derived from the Indian, the question arises, Who introduced it among the Arabs? Was it Alfazârî?

P. 306. *Râvaṇa the demon.*—The author refers to the fifth and sixth books of the *Râmâyaṇa*, which he apparently did not know, or he would not have called it, as he constantly does, *the story of Râma and Râmâyaṇa; v.* pp. 307, 310, and ii. 3. I have not succeeded in deciphering the name of the fortress; the Arabic signs cannot be combined with the name Trikûṭa.

P. 308.—*A straight line from Laṅkâ to Meru* is also mentioned on p. 316. The first degree of longitude, according to the Indian system, is also described in *Sûrya-Siddhânta*, i. 62. Instead of Kurukshetra the author seems to have pronounced *Kurukketru.* At all events, he did not write a *sh.* Therefore the compound *ksh* must have undergone the Prakritic change into *kkh*, as in *pokkharo=pushkara* (Vararuci, iii. 29).

P. 309.—*These wares are deposited, &c.*—This kind of commerce with savage nations is the same as that carried on by Carthage with tribes on the west coast of Africa; *v.* Herodotus, iv. 196; C. Müller, *Geographi Græci Minores*, i. p. xxvii., and Meltzer, *Geschichte der Karthager*, p. 232 and 506.

P. 310.—*Langabâlûs* is identified with the Nicobar

Islands by A. Sprenger, *Post- und Reiserouten des Orients*, p. 88.

P. 312. *Deśântara.—Vide* the rule for its computation in *Sûrya-Siddhânta*, i. 60, 61.
Alarkand, Ibn Ṭâriḳ.—Cf. note to p. 169.

P. 312.—*Al-arkand* is identified by Alberuni with the *Khaṇḍakhâdyaka* of Brahmagupta (ii. 7). In another place (ii. 48) the author identifies the word *arkand* with *ahargaṇa*. Both of these identifications can hardly be justified phonetically, and therefore I prefer to suppose as the Sanskrit original of *Arkand* a word like *Âryakhaṇḍa*, whilst apparently the word *harḳan* (title of an Arabic calendar, ii. 52) is identical with *ahargaṇa*.

The author complains of the Arabic translation of *Al-arkand* being a bad one, and at some time of his life (probably after the composition of the *Indica*) he has published a new and amended edition of this translation. *Cf.* preface to the Arabic edition, p. xx. The Arabic *Arkand* has not yet been discovered in the libraries of Europe. The author has borrowed from this book the following notes:—(1) 1050 yojanas are the diameter of the earth (i. 312, 316). (2) The latitude of Ujain is 22° 29′, and that of Almanṣûra 24° 1′ (i. 316). Here the author states that also Ya‘ḳûb Ibn Ṭâriḳ had quoted the book, but erroneously. (3) The straight shadow in Loharânîî is $5\frac{3}{5}$ digits (i. 316). (4) Alberuni quotes from *Alarkand* a method for the computation of the era *Shakh*, by which the Gupta era is meant (ii. 48, 49).

P. 312.—On the relation between yojana and mile, *v.* note to p. 199.

P. 312, l. 22.—Using the ratio of 7 : 22 between diameter and circumference, we find 3300 yojanas as the circumference corresponding to a diameter of 1050 yojanas. So 3300 yojanas is the circumference of the earth given in the handbook *Al-arkand*. This agrees with the last lines of p. 315, where it is said that 3200 yojanas are 100 yojanas less than the value given by *Al-arkand* (*Schram*).

P. 313. *The author of Karaṇatilaka, i.e. Vijayanandin.* —*Vide* note to p. 156.

P. 313.—*Vyastatrairâśika* is a technical term for a certain algebraic calculation. *Cf.* Colebrooke, "Algebra," p. 34, § 76.

P. 314.—*Alfazârî in his canon,* which was a translation of the *Brahmasiddhânta* of Brahmagupta; *v.* note to pp. 153, 165.

P. 314, l. 11.—The calculation of the *deśântara* is, as Alberuni remarks, quite erroneous, as the difference of longitude is not taken into account (*Schram*).

P. 315, l. 25.—The number in the lacuna must be 80, for Alberuni says at the bottom of the page, "If we invert the calculation and reduce the parts of the great circle to yojanas, according to this method we get the number 3200." But to get 3200 we must multiply $\frac{360}{9}$ by 80. The rule, "Multiply the yojanas of the distance between two places by 9 and divide the product by 80," serves to convert this distance given in yojanas into degrees. This distance, then, is considered as the hypothenuse of a right-angled triangle, one of the sides of which is the difference of the latitudes, the other the unknown difference of the longitudes; this latter is found by taking the root of the difference of the squares of hypothenuse and known side. This difference of longitude is then expressed in degrees; to get it expressed in day-minutes we must further divide by 6, as there are 360° in a circle, but only 60 day-minutes in a day (*Schram*).

P. 316.—*The line connecting Laṅkâ with Meru,* already mentioned on p. 308.

P. 316. *Ya'ḳûb Ibn Ṭâriḳ, Alarkand.*—*Vide* note to p. 169, 312.

P. 317. *Catlaghtagîn.*—Not knowing the etymology of this Turkish name, I am also ignorant of its pronunciation. The second part of the compound seems to be *tagîn* =

valorous, as in Toghrultagîn, *i.e. valorous like a falcon.* As جلغان, *jîlghan*, means a large spear, one might think of reading *Jîlghattagîn*, i.e. *valorous with the spear*, but this is very uncertain. Another name of a similar formation is *kutlughtagîn*, *katlagh*, but probably entirely different. *Vide* Biberstein-Kazimirski, *Menoutschehri* preface, p. 136; Elliot, "History of India," ii. 352, iii. 253.

P. 317.—*Karaṇasâra* by Vitteśvara; *v.* note to p. 156.

P. 317.—The fortress *Lauhûr*, also mentioned p. 208 as Lahûr, must not be confounded with Lauhâvar or Lahore. Situation unknown. According to the author's *Canon Masudicus*, it has latitude 33° 40′, longitude 98° 20′. Comparing these latitudes with those given in Hunter's Gazetteer, we do not find that they much differ:—

	Hunter.	Alberunî.
Ghazna	33° 34′	33° 35′
Kábul	34° 30′	33° 47′
Peshavar	34° 1′ 45″	34° 44′
Jailam	32° 55′ 26″	33° 20′
Siyalkote	32° 31′	32° 58′
Multân	30° 12′	29° 40′

On the identity of Waihand and Attok, *cf.* Cunningham, "Ancient Geography of India," p. 54.

Mandakkakor (the name is differently written) was the fortress of Lahore, according to the author's statement in his *Canon Masudicus*.

Nandna is explained by Elliot ("History of India," ii. 450, 451) as a fort on the mountain Bâlnâth, a conspicuous mountain overhanging the Jailam, and now generally called Tilla. *Cf.* also Elliot, *l. c.* ii. 346, note 347, 366.

The places Dunpûr (pronunciation perfectly uncertain) and *Kandî* (also read Kîrî), *the station of the Amîr*, seem to have been on the road from Ghazna to Peshavar. Near the latter place was fought the decisive battle between King Mas'ûd and his blinded brother Muḥammad, A.D. 1040, and there the former was murdered by the relatives of those who ten years earlier had thought to win his favour by betraying his brother, and were killed or maltreated in reward. *Cf.* Elliot, *l. c.* iv. 199, note 1, 138, ii. 150, 112 (Persian text, p. 274), 273, note 3.

I conjecture Dunpûr to have been identical with Jalalabad or some place near it. Latitude of Jalalabad, 34° 24′; that of Dunpûr, 34° 20′.

Kandî, more southern than Dunpûr and nearer to Kâbul, must have been a place like Gandamak or near it. If it is called *the station (post-relai) of the Amîr*. We may understand by this Amîr the father of King Maḥmûd, the Amîr Sabuktagîn, who first constructed the roads leading to the Indian frontier, as Alberuni informs us on p. 22.

On the identification of Bamhanwâ or Almansûra in Sindh, *v.* Cunningham, *l. l.* p. 271 *seq.*

The statements of Alberuni regarding the Kabul valley and environs have been laid down in a sketch-map of Aloys Sprenger, *Post- und Reiserouten des Orients,* No. 12; the Punjâb and the approaches of Kashmîr, ibid. No. 13.

P. 319.—*Muḥammad Ibn,* &c., is the famous *Razes* of the Middle Ages, who died probably A.D. 932. The author has written a catalogue of his works which exists in Leyden; *v. Chronologie Orientalischer Völker von Alberuni,* Einleitung, p. xi.; Wüstenfeld, *Geschichte der Arabischen Aerzte,* No. 98.

P. 320.—*Alexander of Aphrodisias* is the famous commentator of Aristotle, who lived in Athens about 200 after Christ. *Cf.* Fihrist, p. 252, and Zeller, *Geschichte der Griechischen Philosophie,* 3, 419. The quotation is found in Aristotle, *Phys.* vii. 1.

P. 320. *Varâhamihira.*—This quotation corresponds to *Saṁhitâ,* i. v. 6, 7. Instead of Kumbhaḳa the Sanskrit text has Kaṇâda.

P. 322. *Timæus.*—This quotation seems to be derived from 42 D E:—

τὸ δὲ μετὰ τὸν σπόρον τοῖς νέοις παρέδωκε θεοῖς σώματα πλάττειν θνητά, κ.τ.λ. καὶ λαβόντες ἀθάνατον ἀρχὴν θνητοῦ ζώου, κ.τ.λ.

In the Arabic text, p. ١٦٣, 17, read ماكثة instead of ماثية, and ماكثا instead of ماثيا.

P. 324. *That being who is above him, i.e.* a being of the next higher order.—The opposite of the term لمن يعلوه is لمن دونه (for the being of the next lower order) on p. ١٧٧, 20 (translation i. 351).

P. 325. *Vishṇu-Purâṇa.*—The first words, *Maharlokâ lies, &c., there is one kalpa,* are found in ii. chap. vii. p. 226. The sons of Brahman are mentioned in *Vishṇu-Purâṇa,* ii. 200, note. The name Sanandanâda (Sanandanâtha ?) is perhaps a mistake for Sanâtana. *Cf. Sâṁkhya Kârikâ* with the commentary of Gauḍapâda by Colebrooke-Wilson, p. 1.

P. 325. *Abû-Ma'shar.*—*Vide* note to p. 304.

P. 325. *Alerânshahrî.*—*Vide* note to pp. 6, 7.

P. 327. *The country without latitude, i.e. niraksha* in Sanskrit.—*Vide* p. 267, and *Sûrya-Siddhânta,* xii. 44, note.

P. 330. *Âryabhaṭa of Kusumapura, i.e.* junior.—*Cf.* note to p. 246.

P. 333.—The terms *parârdha* and *kha* have been explained, pp. 175, 178.

P. 334. *The book Srûdhava by Utpala.*—*Vide* notes to pp. 157, 158.

A system of the measures of time has also been given by Colebrooke, "Essays," i. 540 *seq.*

P. 336. *Ś-M-Y.*—This name is so written here and p. 337. The Arabic signs are to be read *Shammî* or *Shamiyyu.* I do not know a Sanskrit name of this form. Is it = *Samaya ?*

The same name seems to occur a third time, ii. 188, but is there written *S-M-Y.* Alberuni says that S-M-Y had *dictated* a method for the computation of the *saṁkrânti ;*

he therefore, perhaps, was a scholar of the time and a personal acquaintance (teacher?) of Alberuni's. The title of a book of his is not mentioned.

P. 338.—*The spêd muhra* or *white shell*, an Indian blowing instrument, is also mentioned by Elliot, "History of India," ii. 215, note.

Purshûr (پرشور), as the manuscript has, is probably a mistake for پرشاور, *Purushâvar*, *i.e.* Peshavar.

P. 338. *Horæ æquinoctiales* and *temporales.*—*Vide* note to p. 214.

P. 339. *The commentator of the Siddhânta, Pulisa.*—Read instead of this, "The commentator of the Siddhânta of Pulisa," and compare note to pp. 153, 154. Who this commentator was is not mentioned.

P. 340.—*Abhijit* means the 8th *muhûrta* of the day. The Arabic form ابجتى corresponds perhaps to Sanskrit *abhijiti.*

P. 340. *Vyâsa.*—This statement points to Mahâbhârata, the Âdi-parvan, v. 4506; but the chronological detail is not found there.

P. 340. *Śiśupâla.*—*Vide* note to p. 165.

P. 342.—The names of the dominants of the *muhûrtas* are also mentioned in the following four lines taken from Aufrecht's Catalogue of the Sanskrit manuscripts of the Bodleian Library, p. 332*a*:—

rudrâhimitrapitaro vasuvâriviśve vedhâ vidhiḥ śatamakhaḥ puruhûtavahnî.

naktaṁcaraś ca varuṇâryamayonayaś ca proktâ dinê daśa ca paṁca tathâ muhûrtâḥ

niśâmuhûrtâ giriśâjapâdâhirbudhnyapûshâśviyamâgnayaśca.

vidhâtṛicaṁdrâditi jîvavishṇutigmadyutitvâshṭrasamîraṇâś ca.

P. 343. *Except the astrologers.*—*Cf.* the meaning of *horâ* in astrology, ii. 222.

P. 343. *Vijayanandin.*—*Vide* note to p. 156. The title of his book would be in Arabic غرّة الزيجات (*Ghurrat-alzîjât*).

P. 344. *Names of the horâs.*—I have not found these names in Sanskrit. Perhaps they are mentioned in some commentary to *Sûrya Siddhânta*, xii. 79.

On *Srûdhava*, *v.* note to p. 158.

P. 347. *Physical scholars know, &c.*—There is a similar passage on the physical effects of moonlight in the author's "Chronology of Ancient Nations," p. 163. I am afraid I have not caught the sense of the sentence, "and that she affects (?) linen clothes," &c.

P. 348. *Atuh* (?).—The MS. seems to read *âtvahhu.*

The word بربه, BRBA, is perhaps a mistake for برکه, *barkhu*, which, according to the table, ii. 197 (*cf.* Trumpp, "Grammar of the Sindhî Language," p. 158), is the name of the first day of a *paksha.*

P. 348. *Veda.*—The author gives six quotations from the *Veda:* one taken from *Patañjali* (i. 29), one from *Sâṁkhya* (i. 31), two from the *Brahmasiddhânta* of Brahmagupta (ii. 110, 111), and two quotations which were probably communicated to him by his Pandits, as he does not mention a particular source whence he took them (i. 348 and ii. 348).

P. 352. *Vâsudeva.*—The quotation corresponds to *Bhagavad-Gîtâ*, viii. 17.

The book Smṛiti.—*Vide* note to p. 131. This quotation seems to have been taken from Manu, *Dharmaśâstra*, i. 72.

P. 353.—The information on the four *mânas* (*cf. Sûrya-Siddhânta*, chap. xiv.), as given by Ya'ḳûb, was the only one at the disposal of Alberuni at the time when he wrote his "Chronology" (*v.* English edition, p. 15). It was communicated to him by the *Kitâb-alghurra* of Abû Muḥammad Alnâ'ib Alâmulî. The *four different kinds of spaces of time* mentioned there are the four *mânas*, *saura*, *sâvana*, *candra* and *nakshatra*.

P. 353.—*Bhukti*, in Arabic *buht*, is the daily motion of a planet; *cf. Sûrya-Siddhânta*, i. 27, note, and here, ii. 195. The Arabic form does not seem to have passed through an intermediate stage of a Prakritic nature, for in Prakrit it would have been *bhuttî* (Vararuci, iii. 1).

P. 355. *The sâvana-mâna is used, &c.*—*Cf.* the similar rules in *Sûrya-Siddhânta*, xiv. 3, 13, 15, 18, 19.

P. 356. *Uttarâyaṇa.*—On the two *ayanas cf. Sûrya-Siddhânta*, xiv. 9.

P. 357. *Ṛitu.*—*Vide* the description of the six seasons in *Sûrya-Siddhânta*, xiv. 10, 16.

P. 358. *Dominants of the halves of the months.*—I do not know a Sanskrit list of these names. The *Âśana* (*Âshunu*) perhaps means *Aśvin* or *Aśvinî*.

P. 359.—*Dimas* (probably pronounced *dimasu*) = Sanskrit *divasa*, is the shibboleth of the Indian vernacular dialect spoken round Alberuni, and probably by himself. I do not know which dialect this was, nor whether there are any traces of it in our days. The change between *v* and *m* is also observed in the following examples:—چرمنمت *carmanmat* = *carmaṇvatî* (Chambal), هممنت *himamant* = *himavant*, جاکملک *jâgamalku* = *yâjnavalkya*, مچی *maccî* = *vatsya*, سکریم *sugrîmu* = *sugrîva*. Some examples of the change of *v* to *m* are also given by Hörnle, "Comparative Grammar," § 134.

P. 359. *The three sounds h, kh, and sh, &c.*—On the pronunciation of *sh* as *kh*, *cf.* Hörnle, *l. c.* § 19, and on the further change of *kh* to *h*, ibid. § 19. Examples of the former change are numerous in the *Indica;* of examples of the latter, *cf.* منهه *munha* = *mukha*, ببرهان *babrahân* = *vaprakhâna* (?), and also آهاری *âhârî*, *cf.* *âshâḍha*, کهکند *kihkind* = *kishkindha.* In Prakrit *muham* = *mukha* (Vararuci, ii. 27).

P. 361. *Srûdhava by Utpala.*—*Vide* note to p. 157.

P. 362. 1 *ghaṭî* = 16 *kalâ.*—*Cf.* with these measures of time the statements on pp. 336, 337.

P. 364, *Chapter XL.*—It has also been translated by Reinaud, *Fragments Arabes et Persans*, pp. 155–160.

P. 364. *Saṁdhi udaya* and *saṁdhi astamana.*—One would expect *saṁdhyudaya* and *saṁdhyastamana*, but there is no trace of a *y*. The forms have a vernacular character, and must be explained according to the analogy of دُتی *duti* = *dyuti*, and انتز *antazu* = *antyaja.*

Hiraṇyakaśipu.—The story of this king and his son Prahlâda is told by the *Vishṇu-Purâna*, ii. 34 *seq.*

P. 366. *Saṁdhi.*—The way it is used in astrology is shown by the table, ii. 219.

P. 366. *Puñjala.*—*Vide* note to p. 157. The tradition here given is very similar to that mentioned by Colebrooke, "Essays," ii. 332, 333.

P. 366, l. 35.—We find that the beginning of the Hindu solar year 854 Sakakala takes place A.D. 932, March 22, 6 *ghaṭî* 40′ 15″, which corresponds to March 22, 7 h. 40 m. civil Greenwich time, whilst the real instant of the solstice is March 15, 12 h. 15 m. civil Greenwich time, so that the solstice precedes the calculation by 6 days and 19 hours, which agrees very well with the 6° 50′ which Puñjala mentions (*Schram*).

P. 368. *Ahargaṇa* = *ahar* + *gaṇa*.—The author's erroneous explanation is repeated ii. 26.

Sind-hind = *siddhânta*.—It may be questioned whether the inorganic *n* has been introduced into the word by the Arabs, or whether it existed already in the pronunciation of the Hindus from whom they learned the word. I do not know of a rule to this effect in Prakrit or vernacular, but there are certain Indian words which apparently show a similar phonetic process. *Cf. e.g.* Prakrit *uṭṭô* (Sanskrit, *ushṭra*), which in Eastern Hindhî has become *ũṭ* or *ûñṭ*. Hörnle, "Comparative Grammar of the Gauḍian Languages," § 149.

P. 370. *Âryabhaṭa, sen.*—*Vide* note to p. 156.
Âryabhaṭa of Kusumapura. *Vide* note to p. 246.
The word I cannot decipher may be read السمف, *i.e.* the article and three consonants with three dots above them, something like الشنف.

P. 371. *Utsarpiṇî, avarsarpiṇî*, are terms employed in the Jaina system. *Cf.* Colebrooke, "Essays," ii. 186, 194.

P. 372. *The book Smṛiti mentions.*—This is Manu, *Dharmaśâstra*, i. 80.

P. 375. *A translation of his whole work, &c.*—*Cf.* note to pp. 153, 154. Alberuni was translating the *Pulisa-Siddhânta*, which until that time had not yet been translated into Arabic by Muslim scholars, because they did not like its theological tendency.

P. 376. *Brahmagupta.*—*Vide* note to pp. 153, 154.

P. 378. In writing the introductory sentences of chap. xliii., the author seems to have had in mind Plato's *Timæus*, 22C: πολλαὶ καὶ κατὰ πολλὰ φθοραὶ γεγόνασιν ἀνθρώπων καὶ ἔσονται, κ.τ.λ.

P. 379. *The pedigree of Hippocrates* is known from Tzetzes, chil. vii. host. 115. *Cf.* "The Genuine Works of Hippocrates," translated by Fr. Adams, London, 1849, vol.

i. p. 23. The name الوسوس seems to be a repetition of the name Hippolochos, ابولوحس. If it is dropped from the list, we have the fourteen generations which the anthor counts between Hippocrates and Żeus.

The Arabic ماطلون seems to be a mistake for ماطاون, *Machaon.*

P. 380. *Paraśurâma.—Vide* this legend in *Vishṇu-Purâṇa*, iv. 19 (here added from the *Mahâbhârata*).

P. 380. *Buddhodana.—Vide* my conjecture as to the origin of this name in note to p. 40.

The *Muḥammira.*—This term has been explained in note to p. 21.

P. 382. *Garga, the son of.*—The name of his father is written *Jashû* or *Jashô* (here and p. 397). Could this be Yaśodâ?

P. 382.—*'Alî Ibn Zain* was a Christian physician in Merw; *cf.* Shahrazûrî, MS. of the Royal Library, Berlin, MS. Or., octav. 217, fol. 144*b*; the same in Baihaḳî, ibid. No. 737, fol. 6*a*. According to this tradition, his son was the anthor of the famous medical book *Firdaus-alḥikma. Cf.* also Fihrist, p. 296 and notes; Wüstenfeld, *Geschichte der Arabischen Aerzte*, No. 55.

The book Caraka.—Vide note to p. 159.

P. 383. *Kriśa, the son of Âtreya.*—If this is what the author means, the Arabic signs صرمس must be altered to مرس. *Cf.* A. Weber, *Vorlesungen*, p. 284, note 309.

P. 383.—The quotation from Aratus is *Phænomena*, vv. 96–134. I give the text from Imm. Bekker, *Aratus cum Scholiis*, Berlin, 1828:—

> Ἀμφοτέροισι δὲ ποσσὶν ὑποσκέπτειο βοώτεω
> Παρθένον, ἥ ῥ' ἐν χερσὶ φέρει Στάχυν αἰγλήεντα.
> εἴτ' οὖν Ἀστραίου κείνη γένος, ὅν ῥά τέ φασιν
> ἄστρων ἀρχαῖον πατέρ' ἔμμεναι, εἴτε τευ ἄλλου,
> εὔκηλος φορέοιτο· λόγος γε μὲν ἐντρέχει ἄλλος

ἀνθρώποις, ὡς δῆθεν ἐπιχθονίη πάρος ἦεν,
ἤρχετο δ' ἀνθρώπων κατεναντίη, οὐδέ ποτ' ἀνδρῶν
οὐδέ ποτ' ἀρχαίων ἠνήνατο φῦλα γυναικῶν,
ἀλλ' ἀναμὶξ ἐκάθητο καὶ ἀθανάτη περ ἐοῦσα.
καί ἑ Δίκην καλέεσκον· ἀγειρομένη δὲ γέροντας
ἠέ που εἰν ἀγορῇ ἢ εὐρυχόρῳ ἐν ἀγυιῇ,
δημοτέρας ἤειδεν ἐπισπέρχουσα θέμιστας.
οὔπω λευγαλέου τότε νείκεος ἠπίσταντο,
οὐδὲ διακρίσιος περιμεμφέος οὐδὲ κυδοιμοῦ·
αὔτως δ' ἔζωον. χαλεπὴ δ' ἀπέκειτο θάλασσα,
καὶ βίον οὔπω νῆες ἀπόπροθεν ἠγίνεσκον·
ἀλλὰ βόες καὶ ἄροτρα καὶ αὐτὴ πότνια λαῶν
μυρία πάντα παρεῖχε Δίκη, δώτειρα δικαίων.
τόφρ' ἦν ὄφρ' ἔτι γαῖα γένος χρύσειον ἔφερβεν.
ἀργυρέῳ δ' ὀλίγη τε καὶ οὐκέτι πάμπαν ὁμοίη
ὡμίλει, ποθέουσα παλαιῶν ἤθεα λαῶν.
ἀλλ' ἔμπης ἔτι κεῖνο κατ' ἀργύρεον γένος ἦεν.
ἤρχετο δ' ἐξ ὀρέων ὑποδείελος ἠχηέντων
μουνάξ· οὐδέ τεῳ ἐπεμίσγετο μειλιχίοισιν·
ἀλλ' ὁπότ' ἀνθρώπων μεγάλας πλήσαιτο κολώνας,
ἠπείλει δὴ ἔπειτα καθαπτομένη κακότητος,
οὐδ' ἔτ' ἔφη εἰσωπὸς ἐλεύσεσθαι καλέουσιν.
οἵην χρύσειοι πατέρες γενεὴν ἐλίποντο
χειροτέρην· ὑμεῖς δὲ κακώτερα τεξείεσθε.
καὶ δή που πόλεμοι, καὶ δὴ καὶ ἀνάρσιον αἷμα
ἔσσεται ἀνθρώποισι, κακοῖς δ' ἐπικείσεται ἄλγος.
ὣς εἰποῦσ' ὀρέων ἐπεμαίετο, τοὺς δ' ἄρα λαοὺς
εἰς αὐτὴν ἔτι πάντας ἐλίμπανε παπταίνοντας.
ἀλλ' ὅτε δὴ κἀκεῖνοι ἐτέθνασαν, οἱ δ' ἐγένοντο,
χαλκείη γενεὴ, προτέρων ὀλοώτεροι ἄνδρες,
οἳ πρῶτοι κακοεργὸν ἐχαλκεύσαντο μάχαιραν
εἰνοδίην, πρῶτοι δὲ βοῶν ἐπάσαντ' ἀροτήρων,
καὶ τότε μισήσασα Δίκη κείνων γένος ἀνδρῶν
ἔπταθ' ὑπουρανίη.

P. 384. *The commentator of the book of Aratus.*—This

commentary is not identical with the scholia edited by Bekker. *Cf. Eratosthenis Catasterismorum Reliquiæ*, rec. C. Robert, pp. 82–84.

P. 385. *Plato.*—This quotation is from *Leges*, iii. 677; but the phrases forming the conversation have been omitted.

ΑΘΗΝ. Τὸ *πολλὰς ἀνθρώπων φθορὰς γεγονέναι κατακλυσμοῖς τε καὶ νόσοις καὶ ἄλλοις πολλοῖς, ἐν οἷς βραχύ τι τὸ τῶν ἀνθρώπων λείπεσθαι γένος, κ.τ.λ. ὡς οἱ τότε περιφυγόντες τὴν φθορὰν σχεδὸν ὄρειοί τινες ἂν εἶεν νομεῖς ἐν κορυφαῖς που, σμικρὰ ζώπυρα τοῦ τῶν ἀνθρώπων γένους διασεσωσμένα, κ.τ.λ. καὶ δὴ τοὺς τοιούτους γε ἀνάγκη που τῶν ἄλλων ἀπείρους εἶναι τεχνῶν καὶ τῶν ἐν τοῖς ἄστεσι πρὸς ἀλλήλους μηχανῶν εἴς τε πλεονεξίας καὶ φιλονεικίας καὶ ὁπόσ᾽ ἄλλα κακουργήματα πρὸς ἀλλήλους ἐπινοοῦσιν.*

P. 387.—*Cf.* with this table *Vishṇu-Purâṇa*, book iii. chap. i. and ii., and the Bombay edition, 1886.

Stâmasa seems to be a mistake for *Tâmasa.*

Caitraka instead of *caitra* seems to have been derived from an erroneous reading of the beginning of the Sanskrit *caitrakiṁpurushâdyâśca.*

Sudivya seems to have risen from a wrong division of the words *Paraśu* (other readings *Parabhu, Parama*) *Divya.* The Bombay edition reads *prajâḥparamadivyâdyâstasya.*

Antata, the name of Indra in the fifth Manvantara, can hardly be combined with the *Vibhu* of Sanskrit tradition.

Síndhu, Reva.—These words, whatever their proper pronunciation may be, are not found in the Sanskrit text.

Puru Muru is Sanskrit *Uru Puru*, but *Pramukha* is a gross mistake, for the text has *urupuruśatadyumnapramukhâḥ*, *i.e.* Uru, Puru, Śatadyumna, and others.

Nabasa and *Dhrishṇa* are mistakes for *Nabhaga* and *Dhṛishṭa.*

Virajas, Aścarvarî, Nirmogha.—The Sanskrit text runs *viracâścorvarîvâṁścanirmohâdyâs,* which Alberuni has divided into *viraja-aścorvarîvâṁśca-nirmoha.* Cf. *Scor-*

varî Vâmśca on p. 394. Wilson reads the second name *Arvarîvat.*

Mahâvîrya, name of Indra in the ninth Manvantara, instead of *Adbhuta*, rests on a misinterpretation of these words: *teshâm indrô mahâvîryô bhavishyatyadbhutô dvija.*

Sudharmâtman.—The Sanskrit text has *Sarvadharmâ.*

Devata Vânupadevâśca, instead of *Devavat* and *Upadeva*, rests on a wrong division of the words *devavânupadevaśca.*

Vicitra-adyâ, a mistake for *vicitrâdyâ, i.e. Vicitra and others.*

Urur, *Gabhî* (*sic* MS.), *Budhnya-adyâ*, a mistake for *urugabhîrabudhnyâdyâ, i.e. Uru, Gabhîra, Budhnya, and others.*

P. 388. *The same book relates*, viz., *Vishṇu-Purâṇa*, iii. p. 20.

On *Priyavrata*, *v.* ibid. ii. p. 101.

P. 389. *A pious woman*, viz., Arundhatî, v. p. 390.

P. 390. On the Seven Ṛishis, or Ursa Major, *cf.* Colebrooke, "Essays," ii. 310.

P. 391. The almanac or calendar from Kashmîr for the Śaka-year 951 (A.D. 1029) is quoted in two other places, ii. 5 and ii. 8.

P. 391. On the ancient astronomer Garga, *cf.* Kern, *Bṛhat Saṁhitâ*, preface, p. 33 *seq.*

P. 392. *Only by 525 years.*—*Cf.* on *Varâhamihira* note to p. 54.

P. 392. *Karaṇasâra* by Vitteśvara.—*Vide* note to p. 156.

P. 394.—This table is taken from *Vishṇu-Purâṇa*, book iii. chaps. i. and ii.

2. *Manvantara: Dattu Nirishabha.*—A mistake for *Dattoni Ṛishabha.*

Niśvara.—Alberuni read *Nirśava.*

Ścorvarî Vâmśca.—The author has wrongly divided the word *śvorvarîvâmiśca* (ed. Bombay *śvorvarîvâmiśca*). *Cf.* note to p. 387.

4. *Manvantara: Jyoti* (read *Jyotis*) *Dhâman.*—Mistake for *Jyotirdhâman.*

Caitrogni, as the author has, is a mistake for *Caitrâgnî.*

Varaka.—Ed. Bombay, *Vamaka;* Wilson-Hall, *Vanaka.*

5. *Manvantara: Rurdhvabâhu* has risen through the wrong division of the two words *vedaśrîrûrdhvabâhu.*

Apara has by mistake been taken for a proper noun in the following words:—*ûrdhvabâhustathâparaḥ.*

Subâhu (*Srabâhu ?*).—The Sanskrit text has *svadhâman.*

6. *Manvantara: Atinâman.*—The Arabic text has *atimânu.* Or are we to read اتنام instead of اتمان ?

Carshayaḥ (= *and the Ṛishis*) by mistake derived from the following passage:—*saptâsannitîcarshayaḥ.*

9. *Manvantara: Havya,* in the Sanskrit tradition *Bhavya.* Perhaps we must read بهب instead of هَبّ.

Medhâdhṛiti (Wilson-Hall), *medhâmṛiti* (ed. Bombay). Alberuni seems to have read *Vedhâdhṛiti,* if we are not to read ميذهادت instead of بيذهادت.

10. *Manvantara: Satya* (Wilson-Hall).—The Arabic has something like *Sattayô.*

Sukshetra.—The Arabic has *Sushera* instead of *Satyaketu.* Perhaps the author has overlooked this word and copied the following one, viz., *Sukshetra.*

11. *Manvantara: Niścara,* in the Arabic *viścara.*

Agnîdhra = *Agnitejas.* The Arabic has *agnîtru* اكنيتر, which is perhaps to be changed to اكنتير (*agnitejas*).

Nagha.—Wilson-Hall, *Anagha.*

12. *Manvantara: Sutaya,* in the Sanskrit text *sutapâśca.* Perhaps the author has read *sutayâśca.*

Dyuti and *Iścânyas* have by mistake been derived from the following verse—

tapodhṛitirdyutiścânyaḥsaptamastutapodhanaḥ.

13. *Manvantara: Tatvadarśîca,* mistake for *Tatvadarṣin,* for the Sanskrit text has *tatvadarśîca.*

Vyaya, mistake for *Avyaya.* The author seems to have read *dhṛitimân vyayaśca* instead of *dhṛitimânavyayaśca.*

14. *Manvantara: Agniba* instead of *Agnibâhuḥ.*

Gnîdhra.—The ed. Bombay reads *mâgadhognîdhraṇvaca.* Other readings, *Gṛîdhra, Agnîdhra.*

Yuktasa and *Jita* are taken from the following verse—

yuktas-tathâ-jitaś-cânyo-manuputrân ataḥ śṛiṇu.

P. 395.—*Vâlakhilyas* are known as pigmy sages from the *Vishṇu-Purâṇa*, but I do not find there this story of them and Śatakratu.

P. 396. *Bali, the son of Virocana*, and his Vazîr *Venus, i.e.* Śukra.—*Vide Vishṇu-Purâṇa*, iii. p. 19, note. There is a Hindu festival called after him *Balirâjya*; *v.* ii. 182.

P. 397. *Vishṇu-Purâṇa.*—This quotation is found III. ii. p. 31.

P. 398.—The second quotation from *Vishṇu-Purâṇa* is III. iii. p. 33.

Kali, the son of Jashô (?).—*Vide* note to p. 382.

P. 398.—The names of tha Vyâsas of the twenty-nine Dvâpara-yugas have been taken from *Vishṇu-Purâṇa*, III. iii. pp. 34–37. The author's tradition differs a little from the Sanskrit text, in so far as he does not always combine the same Vyâsa with the same Dvâpara, particularly towards the end of the list. The names agree in both traditions, except *Trivṛishan*, for which the Arabic has something like *Trivarta* or *Trivṛitta*. Besides, in the word Riṇajyeshṭha (in Arabic *Rinajertu*) the author has made a mistake. The Sanskrit verse runs thus—

kṛitaṁjayaḥ saptadaśe ṛiṇajyoshṭâdaśe smṛitaḥ.

Alberuni has read *ṛiṇajyeshṭoshṭâdaśe* instead of *ṛiṇajyeshṭâdaśe*, and has wrongly divided these words into *ṛiṇajyeshṭo-ashṭâdaśe* instead of *ṛiṇajyo ashṭâdaśe*. Further, he has been guided by the analogy of *jyaishṭha* (the name of the month), which in vernacular was pronounced *jertu*, in changing *ṛiṇajyeshṭa* into *rinajertu.*

P. 398. *Vishṇu-Dharma.*—In mentioning Vâsudeva, Saṁkarshaṇa, &c., as the names of Vishṇu in the yugas, this source agrees with the teaching of the sect of the Bhâgavatas or Pâñcarâtras.—*Vide* Colebrooke, "Essays," i. 439, 440.

P. 401.—The story of the birth of Vâsudeva, *i.e.* Krishṇa, is related in the *Vishṇu-Purâṇa*, book v. chap. iii.

P. 403. *The children of Kaurava, &c.*—The following traditions are taken from the *Mahâbhârata:* the dice-playing from book ii., or *sabhâparvan;* the preparing for battle from book v., or *udyogaparvan;* the destruction of the five brothers by the curse of the Brahmin from book xvi., or *mausalaparvan;* their going to heaven from book xvii., or *mahâprasthânikaparvan.*

The introductory sentence of this relation, وكان اولاد كورو على بنى العمومة, literally, "The children of Kaurava were over their cousins," is odd, and perhaps not free from a lacuna. Pâṇḍu had died, and his children grow up in Hastinapura, at the court of Kaurava, *i.e.* Dhṛitarâshṭra, their uncle, the brother of Pâṇḍu. One expects a sentence like "The children of Kaurava cherished enmity against their cousins," but as the Arabic words run, one could scarcely translate them otherwise than I have done. The children of Kaurava had "the charge of their cousins," &c.

P. 407. On the *akshauhiṇî cf.* H. H. Wilson, "Works," 2d edit., iv. p. 290 (on the art of war as known to the Hindus).

Mankalus seems to be a mistake for *Myrtilus. Cf. Eratosthenis Catasterismorum Reliquiæ,* rec. C. Robert, p. 104. The source of Alberuni seems to have been a book like the chronicle of *Johannes Malalas.*

The second tradition, taken from a commentary on Aratus' *Phænomena* (*vide* note to p. 97), is found in the same book, *Eratosthenis, &c.*, p. 100, 98. For this information I am indebted to my colleague, Professor C. Robert.

P. 408.—The number 284,323 of people who ride on chariots and elephants is a mistake for 284,310. I do not see what is the origin of this surplus of 13 men. However, the wrong number must be kept as it is, since the author reckons with it in the following computation.

ANNOTATIONS.

VOL. II.

P. 1.—The famous chronological chapter xlix. consists of two parts of very different value. Part i., on p. 2–5, an explanation of the mythical eras of the Hindus, is taken from the *Vishṇu-Dharma*, on which work *cf.* note to i. p. 54.

Part ii., on p. 5–14, containing information of a historical character, has not been drawn from a literary source. If the author had learned these things from any particular book or author, he would have said so. His information is partly what educated people among Hindus believed to be historic and had told him, partly what he had himself observed during his stay among Hindus and elsewhere. That their historic tradition does not deserve much credit is matter of complaint on the part of the author (on pp. 10, 11), and that altogether the description of historic chronology, as far as he was able to give it, is by no means in all points satisfactory, is frankly admitted by the author himself (on p. 9). Whatever blame or praise, therefore, attaches to this chapter must in the first instance be laid to the charge, not of Alberuni, but of his informants. What he tells us is to be considered as the *vulgata* among educated Hindus in the north-west of India in his time.

Although the tales which had been told Alberuni may not have been of a high standard, still it is much to be regretted that he has not chosen to incorporate them into his *Indica* (*cf.* p. 11, 1–6).

Whether his hope (expressed on p. 8), that he might some day learn something more of this subject, was realised or not, I cannot make out. However, the stray notes on Indian chronology scattered through his *Canon Masudicus*, which he wrote some years after the *Indica*, do not seem to betray that his Indian studies had made much progress.

In all researches on Indian chronology, Alberuni's statements play an eminent part, specially those relating to the epochs of the Śaka and Gupta eras. *Cf.* among others the following publications:—

Fergusson, "On Indian Chronology," "Journal of the Royal Asiatic Society," vol. iv. (1870), p. 81; and "On the Saka, Samvat, and Gupta Eras," vol. xii. (1880), p. 259.

E. Thomas, "The Epoch of the Guptas," ibid. vol. xiii. (1881), p. 524.

Oldenberg, "On the Dates of Ancient Indian Inscriptions and Coins," "Indian Antiquary," 1881, p. 213.

Fleet, "The Epoch of the Gupta Era," ibid., 1886, p. 189.

Drouin, "Chronologie et Numismatique des Rois Indo-Scythes," in "Revue Numismatique," 1888, premier trimestre, pp. 8 *seq.*

M. Müller, "India, What can it teach us?" pp. 281, 286, 291.

P. 2.—As the author had to compare a number of different eras with each other, he stood in need of a common standard to which to reduce all of them, and for this purpose he chose the New-Year's Day or first Caitra of the year 953 of the Śaka era, which corresponds to—

(1.) A.D. 1031, 25th February, a Thursday.
(2.) A. Hijrae 422, 28th Ṣafar.
(3.) A. Persarum 399, 19th Ispandârmadh-Mâh.

The Naurôz or New-Year's Day of the Persian year 400 fell on 9th March 1031 A.D., which is the day 2,097,686 of the Julian period (*Schram*).

P. 2, l. 30.—This refers to the year of the kaliyuga 3600, as there have elapsed 10 divya years or 3600 years of the present yuga. On the next page Alberuni makes the calculation for the gange-year, or the year 4132 of the kaliyuga. A kalpa being a day of Brahman, 8 years, 5 months, 4 days correspond to 8 × 720 + 5 × 60 + 4 × 2, or 6068 kalpas, or 26,213,760,000,000 years. Of the present kalpa there have elapsed six manvantaras or 1,840,320,000 years, seven samdhis or 12,096,000 years, twenty-seven caturyugas or 116,640,000 years, the kritayuga or 1,728,000 years, the tretayuga or 1,296,000 years, the dvaparayuga or 864,000 years, and of the kaliyuga 4132 years; so altogether of the seventh manvantara 120,532,132 years, of the kalpa 1,972,948,132 years, and of Brahman's life 26,215,732,948,132 years, as stated p. 3, ll. 6–9 (*Schram*).

P. 3. *It was I who told it to Yudhishṭhira, &c.*—The author of *Vishṇu-Dharma* refers in these words to the third *parvan* (*vanaparvan*) of the *Mahâbhârata.*

P. 4, l. 29.—From the beginning of Brahman's life to that of the present kalpa there have elapsed 6068 kalpas or 6068 × 1008 × 4,320,000 or 26,423,470,080,000 years. Six manvantaras = 6 × 72 × 4,320,000 or 1,866,240,000 years; twenty-seven cataryugas = 27 × 4,320,000 or 116,640,000 years; three yugas + 4132 years = 3 × 1,080,000 + 4132 or 3,244,132 years. The latter number represents the years elapsed of the caturyuga; adding to it successively the other numbers of years, we find the numbers given ll. 29–31 of this page. The Arabic manuscript has 26,425,456,200,000 instead of 26,425,456,204,132 (*Schram*).

P. 6, l. 3.—In the book *Srûdhava, &c.*, *cf.* note to i. p. 158.

Candrabîja.—I first took the reading of the manuscript to be جنّدربهر, but now I believe I can see a pale dot above the last consonant, so that we may read جندربهز.

On the *shashṭyabda*, or sixty-years cycle, *cf.* chap. lxii. p. 123.

P. 6. *The epoch of the era of Śaka, &c.*—Alberuni speaks of this era in his *Canon Masudicus* (composed during the reign of Mas'ûd) in the following terms: الوقت بلغة الهند هو كال واشهر التواريخ عندهم وخاصّة عند منجّميهم شككال اى وقت سك ويحسب من سنة هلاكه لانّه كان متغلّبا عليه والرسم فيه وفى غيره ان تذكر سنيه التامّة دون الناقصة. (Beginning of the sixth chapter, book i., copied from the Codex Elliot, now in the British Museum.)

Translation: "*Time* is called *Kâla* in the language of the Hindus. The era most famous among them, and in particular among their astronomers, is the *Śakakâla,* i.e. *the time of Śaka.* This era is reckoned from the year of his destruction, because he was ruling (rather, tyrannising) over it (*i.e.* over that time). In this as well as in other eras it is the custom to reckon only with complete, not with incomplete or current years."

Then the author goes on to give rules for the comparison of the Śaka era with the Greek, Persian, and Muslim eras.

A later author, 'Abû-Sa'îd 'Abd-alḥayy Ibn Alḍaḥḥâk Ibn Maḥmûd Gardêzî (Gardez, a town east of Ghazne), has reproduced the information of Alberuni on the Śaka era in Persian. Not having the original (MS. Ouseley 240, Bodleian Library, Oxford) at my disposal, I give a translation made years ago:—

"The Hindu era is called شککال, because کال (*kâla*) means *time*, and شک (*Śaka*) is the name of a king whose death was made an era; he did the Hindus a great deal of harm, so they made the date of his death a festival" (Oxford manuscript, p. 352).

The place *Karûr* is also mentioned in the *Chachnâma*. *Vide* Elliot, "History of India," i. 139, 143, 207.

P. 7. *Al-arkand.*—*Cf.* note to i. 312. The book does not seem to exist in the collections of Arabic manuscripts in Europe.

P. 8.—The pronunciation of the names Kanîr, Bardarî, Mârîgala, and Nîrahara (Nîra-gṛiha ?) is more or less conjectural.

Alberuni identifies *Mârîgala* with *Takshaśila* (vol. ii. 302), *i.e.* the Taxila of the ancients. The name *Mârîgala* seems to be preserved in that of a *range of hills lying only two miles to the south of Shahdhesi* (Cunningham, "Ancient Geography of India," p. 111). The place is also mentioned in the *Ṭâbaḳâti-Nâṣirî*. *Vide* Elliot, "History of India," ii. 271, 273.

P. 9.—*Durlabha*, a native of Multân, is only twice mentioned. Here the author quotes from him a method for the computation of the Śaka era, and p. 54 a method for the computation of *ahargaṇa*. According to him, the Indian year commenced with the month Mârgaśîrsha, but the astronomers of Multân commenced it with Caitra (p. 10).

P. 10. *Barhatakîn.*—The name occurs only in this one place. If it were an Indian name, I should think of something like *Vrihatkina* (or *Vrihatketu* برهتكيت). If it is Turkish, it is a compound, the second part of which is *tagin* (as in *Toghrultagin* and similar names). As the author declares the dynasty to be of Tibetan origin, the question is whether the name may be explained as Tibetan.

P. 10. *Var.*—As the Arabic verb may be connected either with the preposition *bi* or with the accusative, we may read either *bvr* or *vr*.

P. 10, l. 25. *He began to creep out.*—In the Arabic text, p. ٢٠٧, 8, read اخذ يخرج instead of احد يخرج.

P. 11. *Kanik.*—Only the three consonants *KNK* are certain. We may read them *Kanik* or *Kanikku*, which would be a Middle-Indian *Kanikkhu* for Sanskritic *Kanishka*. Thus the name Turk was pronounced by the Middle-Indian tongue as *Turukkhu*, and Sanscritisized as *Turuskha*.

This Zopyrus-story was reproduced by Muḥammad 'Aufī. *Cf.* Elliot, "History of India," ii. 170.

P. 13. *Lagatûrmân.*—The uncouth formation of this name seems to point to a Non-Indian (Tibetan?) origin. I at first thought to combine it with the name of the Tibetan king, *Langtarma*, who abolished Buddhism, A.D. 899 (*v.* Prinsep, "Useful Tables," ii. 289), as our Lagatûrmân was the last of a series of Buddhistic kings, and as the names resemble each other to some extent. However, this combination seems delusive.

The name Kallar is written *Kallr* كلّر. Could this name be combined with *Kulusha* (Kalusha?), which *e.g.* occurs as the name of the Brahmin minister of the Mahratta Râja Sambajî?

P. 13, l. 17. *The Brahman kings.*—The word *sâmanta* means *vassal.*

Kamalû was a contemporary of the prince 'Amr Ibn Laith, who died A.D. 911. *Cf.* Elliot, "History of India," ii. 172. Is the name a hypokoristikon of one like *Kamalavardhana?*

Ânandapâla, *Bhîmapâla*, and *Trilocanapâla* mean *having Śiva as protector.* If, therefore, these princes, like the Indo-Scythian kings (*cf.* Drouin, *Revue Numismatique*, 1888, 48), were Śiva-worshippers, we must explain the name *Jaipâl* perhaps as *Jayâpâla*, i.e. *having Durgâ* (the wife of Śiva) *as protector.* *Cf.* the Hindu kings of Kabul in Elliot, "History of India," ii. 403 *seq.* (in many points antiquated).

The name *Trilocanapâla* (here *Tarûcanpâl*) has been much disfigured in the Arabic writing. *Vide* the Puru Jaipal in Elliot, *l.c.*, ii. 47, 463, 464.

P. 13, l. 14. *The latter was killed.*—The Arabic manuscript has قىل, which may be read قيل (*narratum est*) or قتل (*interfectus est*). I have not been able to ascertain whether the year in question was that of the enthronisation of Trilocanapâla, or that of his death. I prefer, however (with Reinaud), to read قتل, "*he was killed*," because evidently the author stood so near to the events in question that he could have ample and trustworthy information, and that, in fact, an *on dit* (قيل) seems here entirely out of place.

P. 13, l. 22. *The slightest remnant*, literally *one blowing fire*, a well-known simile for *nobody*. *Cf. e.g.* Hasan Nizâmî in Elliot's "History of India," ii. 235, l. 13.

P. 15.—For Alfazârî and Ya'ḳûb Ibn Ṭariḳ, *cf.* note to i. 165, 169.

Muḥammad Ibn Isḥâḳ of Sarakhs is mentioned only here and in the tables on pp. 16 and 18, besides in Alberuni's "Chronology" (English edition, p. 29).

P. 16, l. 6 of the table.—It is not clearly said in the text that the anomalistic revolution is meant, but the numbers which Alberuni quotes leave no doubt on the subject. The days of a kalpa are 1,577,916,450,000, which being divided by the number 57,265,194,142, give for one revolution $27\frac{31756208166}{57265194142}$ days, or 27 days 13 h. 18 min. 33 sec., whilst the anomalistic revolution of the moon is equivalent to 27 days 13 h. 18 min. 37 sec., an agreement so very close, that every doubt that there could be meant anything but the anomalistic revolution is completely excluded. Moreover, the number of the revolutions of the apsis, 488,105,858, being augmented by 57,265,194,142, is equal to 57,753,300,000, the number of sidereal revolutions; and, indeed, the revolutions of the apsis, *plus* the anomalistic revolutions, must be equal to the sidereal revolutions (*Schram*).

P. 16.—The note in the table "The anomalistic revolution of the moon is here treated," &c., is not quite clear, and probably materially incorrect. That the term حاصّة القمر means the anomaly (*ἀνωμαλία* in Greek, *kendra* (*κέντρον*) in Sanskrit), was first pointed out to me by my friend and colleague, Prof. Förster; but this note, which seems to be intended as a sort of explanation of the term, does not exactly render what astronomers understand by *anomaly*. Literally translated it runs thus: "The *Ḥâṣṣat-alḳamar* stands in the place of the *apsis*, because the result is its (whose? the apsis'?) share, since it (the *ḥâṣṣat-alḳamar*) is the difference between the two motions" (لأنّ ما يخرج يكون حصّته الى (not او) هى فضل ما بين الحركتين). Accordingly, we must translate the term as "falling to the moon as her lot or share," viz., movement, in Arabic الحركة الحاصّة القمر. Therefore, in the Arabic text, pp. ٢٠٩ and ٢١٠, 8 write حاصّة intead of خاصّة.

P. 19.—Abû-alḥasan of Ahwâz is mentioned only in this place. He seems to have been a contemporary of Alfazârî and Ya'ḳûb Ibn Ṭâriḳ.

P. 20.—*Annus procrastinationis.*—*Vide* the author's "Chronology" (English edition), p. 73. *Malamâsa*, in Hindustani *malmâs*. *Vide* Dowson, "Hindustani Grammar," p. 258.

P. 21, l. 24.—A caturyuga or 4,320,000 solar years consists of 53,433,300 lunar months or 1,602,999,000 lunar days; so one solar year has $371\frac{31}{480}$ lunar days, and the difference between the solar and lunar days of a year is $11\frac{31}{480}$. The proportion 360 : lunar days : $11\frac{31}{480}$ days $= x$ lunar days : 30 days gives for x the number of

$976\frac{404}{5311}$, which is equivalent to $976\frac{4176}{54900}$. *Vide* p. 24, l. 23 (*Schram*).

P. 22, l. 17.—Read 22^{iii} instead of 23^{iii} (*Schram*).

P. 23. *Padamâsa.*—This seems to be an old mistake which has crept into the Arabic manuscripts of the works of Alfazârî and Ya'ḳûb. *Cf.* the author's "Chronology" (English edition), p. 15.

P. 27.—The rule given in the first fifteen lines of this page is completely erroneous, and consequently the example calculated after this rule is so too. The right method would be the following:—"The complete years are multiplied by 12; to the product are added the months which have elapsed of the current year. The sum represents the partial solar months. You write down the number in two places; in the one place you multiply it by 5311, *i.e.* the number which represents the universal adhimâsa months. The product you divide by 172,800, *i.e.* the number which represents the universal solar months. The quotient you get, *as far as it contains complete months*, is added to the number in the second place, and the sum so obtained is multiplied by 30; to the product are added the days which have elapsed of the current month. The sum represents the candrâhargaṇa, *i.e.* the sum of the partial lunar days." These two proceedings would be identical, if we were not to omit fractions; but as an adhimâsa month is only intercalated when it is complete, we must first determine the number of adhimâsa months, and, *omitting the fractions*, change them to days; whilst when we multiply beforehand by 30, the fractions of the adhimâsa months are also multiplied, which is not correct. This is at once seen in the example which he works out after this rule, and we wonder that Alberuni himself did not see it. He is calculating the ahargaṇas for the beginning of a year, consequently also for the beginning of a month, and, notwithstanding, he is not at all surprised to find (p. 30) 28 days and 51 minutes of the month already passed.

The adhimâsa days are nothing else than adhimâsa months converted into days. As the number of the adhimâsa months must be a whole, so the number of the adhimâsa days must be divisible by 30. Accordingly, the number quoted, p. 29, l. 30, not being divisible by 30, is at once recognised as erroneous, and it is astonishing when he says in the following lines, "If, in multiplying and dividing, we had used the months, we should have found the adhimâsa months and multiplied by 30, they would be equal to the here-mentioned number of adhimâsa days." In this case certainly the number ought to be divisible by 30. Perhaps he would have found the fault, if not, by a strange coincidence, the difference between the true value and the false one had been exactly 28 days or four complete weeks, so that though the number considered is an erroneous one, yet he finds, p. 30, l. 9, the right week-day.

Alberuni finds, p. 29, l. 2, as the sum of days from the beginning of the kalpa to the seventh manvantara 676,610,573,760. Further, he finds, l. 7, that from the beginning of the seventh manvantara till the beginning of the present caturyuga there have elapsed 42,603,744,150 days, and, l. 12, that till the beginning of the kaliyuga there have elapsed 1,420,124,805 days of the present caturyuga. Adding these numbers, we find that the sum of days elapsed from the beginning of the kalpa to that of the caturyuga is 720,634,442,715; but as he finds, p. 30, l. 5, that from the same epoch to the gauge-date there have elapsed 720,635,951,963 days, so the gauge-date would be 1,509,248 days after the beginning of the kaliyuga. Now we know that the gauge-date is 25th February 1031 (see p. 2, l. 17, and note), or the day 2,097,686 of the Julian period, whilst the first day of the kaliyuga, as is generally known, coincides with the 18th February 3102 before Christ or with the day 588,466 of the Julian period, so that the difference of the two dates is 1,509,220, and not 1,509,248 days.

To this result we shall also come when working out Alberuni's example after the method stated in the beginning of this note. Instead of p. 29, l. 16, we should then have: the years which have elapsed of the kalpa up to that year are 1,972,948,132. Multiplying them by 12, we get as the number of their months 23,675,377,584. In the date which we have adopted as gauge-year there is no month, but only complete years; therefore we have nothing to add to this number. It represents the partial solar months. We multiply it by 5311 and divide the product by 172,800; the quotient $727,661,633\frac{3463}{3600}$ represents the adhimâsa months. Omitting the fractions, we add 727,661,633 to the partial solar months 23,675,377,584, and get 24,403,039,217 as the partial lunar months. By multiplying this number by 30 we get days, viz., 732,091,176,510. As there are no days in the normal date, we have no days to add to this number. Multiplying it by 55,739 and dividing the product by 3,562,220, we get the partial ûnarâtra days, viz., $11,455,224,575\frac{193439}{356222}$. This sum of days without the fraction is subtracted from the partial lunar days, and the remainder, 720,635,951,935, represents the number of the civil days of our gauge-date. Dividing it by 7, we get as remainder 4, which means that the last of these days is a Wednesday. Therefore the Indian year commences with a Thursday. The difference between 720,635,951,935 and the beginning of the kaliyuga 720,634,442,715 is, as it ought to be, 1,509,220 days (*Schram*).

In the beginning of chap. lii., in the Arabic text, ٢١٦, 8, it seems necessary to write شهور and الشهور instead of ايّام and الايّام.

P. 29, l. 10. *Thursday.*—The Arabic manuscript has *Tuesday.*

P. 30, l. 10–17.—This ought to run as follows:—We have found above $727,661,633\frac{3463}{3600}$ for the adhimâsa months; the wholes represent the number of the adhimâsas which have elapsed, viz., 727,661,633, whilst the fraction is the time which has already elapsed of the current adhimâsa month. By multiplying this fraction by 30 we get it expressed in days, viz., $\frac{3463}{120}$ days, or 28 days 51 minutes 30 seconds, so that the current adhimâsa month wants only 1 day 8 minutes 30 seconds more to become a complete month (*Schram*).

P. 31, l. 19.—The number 1,203,783,270 is found by adding the 30 × 1,196,525 or 35,895,750 adhimâsa days to the 1,167,887,520 solar days (*Schram*).

P. 31, l. 24.—The number of days from the beginning of the caturyuga to the gauge-date is here found by Pulisa's method to be 1,184,947,570, whilst p. 33, l. 16, the number of days from the beginning of the caturyuga to that of the kaliyuga is found to be 1,183,438,350. The difference between both numbers is (as it ought to be) 1,509,220 days (*Schram*).

P. 33, l. 24.—The method of Âryabhaṭa is the same as that given before, only the numbers by which we are to multiply and to divide, are different according to his system, which supposes a different number of revolutions in a kalpa. According to Âryabhaṭa the elder, a caturyuga has 1,577,917,500 days (see vol. i. p. 370, l. 28). As to the revolutions of sun and moon, they seem to be the same as given by Pulisa. The tables, pages 16 and 17, are not quite correct in this, as they give, for instance, for the revolutions of the moon's node and apsis the 1000th part of their revolutions in a kalpa, whilst in vol. i. p. 370, l. 16, it is said that, according to Pulisa and Âryabhaṭa, the kalpa has 1008 caturyugas. But p. 19, l. 15, the numbers 4,320,000 for the sun and 57,753,336 for the moon are given as possibly belonging to the theory of Âryabhaṭa. The same numbers are cited by Bentley in his "Historical View of the Hindu Astronomy," London, 1825, p. 179, as belonging to the system of the so-called spurious Ârya Siddhanta. It is doubtless the same system, for if we compare the number of days between the beginning of the kalpa and that of the kaliyuga, which Bentley states in the above-cited book, p. 181, to be 725,447,570,625, with the same sum quoted by Alberuni, p. 33, l. 29, there can scarcely be a doubt as to the identity of both systems, especially as this number 725,447,570,625 is a curious one, giving Thursday for the first day of the kalpa, whilst the other systems give Sunday for this date. Of this book Bentley says, p. 183: "It would be needless to waste any more time in going over its contents; what has been shown must be perfectly sufficient to convince any man of common sense of its being a downright modern forgery;" and p. 190, "The spurious Brahma Siddhanta, together with the spurious Ârya Siddhanta, are doubtless the productions of the last century at farthest." Perhaps he would have chosen more reserved expressions, if he had known that this "production of the last century" was already cited by Alberuni.

When we adopt these numbers for a caturyuga, *i.e.* 1,577,917,500 civil days, 4,320,000 revolutions of the sun and 57,753,336 revolutions of the moon, and consequently 53,433,336 lunar months, we find the numbers belonging to a yuga by dividing the above numbers by four, as in this system the four yugas are of equal length. Thus we get for a yuga 394,479,375 civil days, 1,080,000 solar years, and consequently 12,960,000 solar months, and 388,800,000 solar days, 13,358,334 lunar months, 400,750,020 lunar days, 398,334 adhimâsa months, and 6,270,645 ûnarâtra days. To find the number 725,449,079,845 mentioned, p. 33, l. 31, as the sum of days between the beginning of the kalpa and the gauge-date, we are to proceed as follows:—From the beginning of the kaliyuga to our gauge-date there have elapsed 4132 years, which multiplied by 12 give 49,584 as the partial solar months. This number multiplied by the universal adhimâsa months 398,334, and divided by the universal solar months 12,960,000, gives $1523\frac{44837}{45000}$ as the number of adhimâsa months. This number, without the fraction added to the solar months 49,584, gives 51,107 as the number of the partial lunar months, which multiplied by 30 gives 1,533,210 as the number of the partial lunar days. This number multiplied by the universal ûnarâtra days 6,270,645 and divided by the universal lunar days 400,750,020 gives $23,990\frac{2473785}{4452778}$ as the sum of the partial ûnarâtra days; and 23,990 subtracted from the partial lunar days 1,533,210 gives 1,509,220 as the civil days elapsed of the kaliyuga till the gauge-date, identical with the number found in note to p. 27. These 1,509,220 days added to the 725,447,570,625 days which separate the beginning of the kalpa and the kaliyuga, give the number of 725,449,079,845 days cited p. 33, l. 31. Finally, the number of days elapsed of Brahman's life before the present kalpa, is got by multiplying the number of days in a kalpa, *i.e.* 1,590,540,840,000 (see page 370, vol. i.) by 6068, the number of the kalpas elapsed before the present one (*Schram*).

P. 34, l. 32.—There is here the same fault as that which led Alberuni to a false result, p. 27. The multiplication by 30 must be made after dropping the fraction of the adhimâsa months, not before (*Schram*).

P. 36, l. 1.—The lacuna must have contained a phrase like this:—"In three different places; they multiply the number in the lowest place by 77, and divide the product by 69,120." This follows clearly from the explanation which he gives in the following page (*Schram*).

P. 36, l. 9.—Read *lunar* instead of *solar*, in the Arabic (٣٤, 7, last word), القمريّة instead of الشمسيّة.

P. 36, l. 10.—The expression is a very concise one, so that it is not quite clear what is meant (l. 14) by the "middle number."—It is to be understood in the following manner: "This number of the partial lunar days is written down in two different places, one under the other. The one of these is "in the uppermost place" (l. 17); they multiply the lower number by 11, and write the product under *it*. Then they divide it, *i.e.* the product, by 403,963, and add the quotient to the middle number, *i.e.* to the product of eleven times the partial lunar days (*Schram*).

P. 36, l. 26.—A certain number of months A is to be divided by $65\frac{1155}{15933}$. If we wish to get the same result by dividing only by 65, we must subtract from A a certain number X which is to be determined by the equation $\frac{A}{65\frac{1155}{15933}}=\frac{A-X}{65}$. This equation gives for X the value $X=A\left(\frac{\frac{1155}{15933}}{65\frac{1155}{15933}}\right)$, or, reduced, $X=A(\frac{1155}{1036800})$, or at last $X=A(\frac{77}{69120})$. The equation $X=A\left(\frac{\frac{1155}{15933}}{65\frac{1155}{15933}}\right)$ can also be written in the form $65\frac{1155}{15933}:\frac{1155}{15933}=A:X$, that is, as Alberuni states it (l. 30), "the whole divisor stands in the same relation to its fractions as the divided number to the subtracted portion" (*Schram*).

P. 36, l. 33.—Alberuni has not made the calculation given above in a general way, but he has made it only for a special case, for the gauge-date. He finds the fraction $\frac{77}{69120}$, which he would find for every other date, as this fraction is independent of the number A (*Schram*).

P. 37, l. 26.—Here again a certain number of ûnarâtra days A is to be divided by $63\frac{50663}{55739}$. If we wish to get the same result by dividing only by $63\frac{10}{11}$, or, which is the same, by $\frac{703}{11}$, we must add to A a certain number X, which is determined by the equation

$$\frac{A+X}{\frac{703}{11}}=\frac{A}{63\frac{50663}{55739}} \text{ or } A+X=A\left(\frac{703}{11\times 63\frac{50663}{55739}}\right) \text{ or } X=A\left(\frac{703-11\times 63\frac{50663}{55739}}{11\times 63\frac{50663}{55739}}\right)$$

$$=A\left(\frac{703-702\frac{55642}{55739}}{702\frac{55642}{55739}}\right) \text{ or } X=A\left(\frac{\frac{97}{55739}}{\frac{39184420}{55739}}\right)=A\left(\frac{97}{39184420}\right)$$

or at last, dividing numerator and denominator by 97, we find $X=\frac{A}{403963\frac{9}{97}}$. The $\frac{9}{97}$ are neglected (see p. 38, l. 9) (*Schram*).

P. 38, l. 25.—The Arabic manuscript has 77,139, instead of 7739, as Dr. Schram demands; *v.* p. 39, l. 7, and p. 40, l. 8.

P. 39, l. 20.—Here he grants that the 28 days which we get over 727,661,633 months are to be reckoned after the beginning of the month Caitra, so that the result found, p. 29, l. 30, agrees with the 28th, not with the first Caitra (*Schram*).

P. 39, l. 24.—The middle number was multiplied by $\frac{2481}{9600}$; a solar year has $365\frac{2481}{9600}$ days (l. 36), or 52 weeks 1 day and $\frac{2481}{9600}$ of a day. By adding the product of the number of years multiplied by $\frac{2481}{9600}$ to this number itself, we get the sum of days by which these years exceed whole weeks. The rest of the calculation is sufficiently explained by Alberuni himself (*Schram*).

P. 41, l. 19.—This is the same case as p. 36, only the numbers are a little different. If A is the number of months to be divided by $32\frac{35552}{66389}$, and we wish to subtract a number from A so as to get the same result by dividing the difference by 32 only, we have the equation

$$\frac{A}{32\frac{35552}{66389}}=\frac{A-X}{32}$$

which gives for X the value

$$A\left(\frac{\frac{35552}{66389}}{32\frac{35552}{66389}}\right) \text{ or } X=A\left(\frac{35552}{2160000}\right) \text{ or } X=A\left(\frac{1111}{67500}\right).$$

Alberuni has again made the calculation for a special case, the gauge-date, and found the same fraction (*Schram*).

P. 41, l. 20.—"This number of days," viz., the number of solar days corresponding to the given date (*Schram*).

P. 41, l. 33.—The MS. has 974 instead of 976.

P. 42, l. 3.—The number of solar days, 1,555,222,000, is here taken as divisor instead of the number of adhimâsa months, 1,593,336. The fraction ought to be $976\frac{104064}{1593336}$ $=976\frac{4336}{66389}$, the common divisor 24 (*Schram*).

P. 42, l. 6.—Alberuni does not seem to have understood Pulisa's calculation which is correct, although there seems to be a lacuna in its explanation. According to Pulisa's theory, there are in a caturyuga 1,555,200,000 solar days and 1,593,336 adhimâsa months. Dividing the first number by the second, we get as the time within which an adhimâsa month sums up $976\frac{104064}{1593336}$ days. So one would get the number of adhimâsa months by dividing the given number of solar days by the number $976\frac{104064}{1593336}$; but Pulisa prefers not to reckon with the fraction, so he diminishes the number of given days by a certain amount and divides only by 976. The number which is to be subtracted from the given days is easily found by the following equation:—

Let D be the number of given solar days; we then have

$$\frac{D}{976\frac{104064}{1593336}}=\frac{D-X}{976} \text{ or } X=D\left(\frac{\frac{104064}{1593336}}{976\frac{104064}{1593336}}\right) \text{ or } X=D\left(\frac{\frac{104064}{1593336}}{\frac{1555200000}{1593336}}\right)$$

$$\text{or } X=D\left(\frac{104064}{1555200000}\right).$$

Now 384 is a common divisor to 104,064 and the divisor 1,555,200,000. So we get $X=D\frac{271}{4050000}$, just as Pulisa finds it (*Schram*).

P. 42, l. 22.—Not only is it not "quite impossible that this number should, in this part of the calculation, be used as a divisor," but it needs must be used as a divisor. This we see at once when, instead of working out the calculation with special numbers, we make it algebraically. Let S be the number of solar days in a caturyuga, and A the number of adhimâsa months in a caturyuga. Then the number of days within which one adhimâsa month sums up, will be found by dividing S by A. By this division we shall get wholes and a fraction; let the wholes be represented by Q and the numerator of the fraction by R. We then have $\frac{S}{A}=Q+\frac{R}{A}$ or $S=AQ+R$. Now if, the given number of solar days being D, we have to divide D by $Q+\frac{R}{A}$ to get the number of adhimâsa months, but as we wish to divide by Q alone, we must subtract from D a number X, which will be found by the equation

$$\frac{D}{Q+\frac{R}{A}}=\frac{D-X}{Q} \text{ or } X=D\left(\frac{\frac{R}{A}}{Q+\frac{R}{A}}\right) \text{ or } X=D\left(\frac{R}{AQ+R}\right)$$

As $AQ+R$ is equal to S, we have $X=D\frac{R}{S}$, where S is the number of solar days in a caturyuga, which must necessarily be a divisor in this part of the calculation (*Schram*).

P. 42, l. 31.—As one ûnarâtra day sums up in $63\frac{50663}{55739}$ lunar days (see p. 37, l. 17), we have again the equation

$$\frac{L}{63\frac{50663}{55739}}=\frac{L-X}{63} \text{ or } X=L\left(\frac{\frac{50663}{55739}}{63\frac{50663}{55739}}\right) \text{ or } X=L\left(\frac{50663}{3562220}\right)$$

where L represents the number of the given lunar days.

P. 44, l. 1.—The number 720,635,951,963 is not correct, as we have seen in note to p. 27. It is too great by 28 days. But the number of adhimâsa days, 21,829,849,018 (l. 10), is also 28 days too great. So the difference is again correct. There is the same fault as at p. 27. The calculation ought to run as follows:—The partial civil days which have elapsed up to our gauge-date are 720,635,951,935. This number is given, and what we want to find is how many Indian years and months are equal to this sum of days. First we multiply the number by 55,739 and divide the product by 3,506,481; the quotient is 11,455,224,575$\frac{1034309}{3506481}$ ûnarâtra days. We add 11,455,224,575 to the civil days; the sum is 732,091,176,510 lunar days. Dividing this number by 30, we get as quotient 24,403,039,217 lunar months (and no fraction; so we see that the date in question consists of a number of months only, or, what is the same, that the date corresponds to the beginning of a month). Multiplying the lunar months by 5311 and dividing the product by 178,111, we get 727,661,633$\frac{166224}{178111}$ adhimâsa months; 727,661,633 adhimâsa months subtracted from the 24,403,039,217 lunar months give 23,675,377,584 solar months, which divided by 12 give 1,972,948,132 years and no fraction. So we find the given date corresponding not only to the beginning of a month, but also to that of a year. We find the same number of years of which the gauge-date consists (see p. 29, l. 17) (*Schram*).

P. 45, l. 12.—This rule must indeed be based on some complete misunderstanding, for it is absolutely erroneous, as Alberuni rightly remarks (*Schram*).

P. 46, l. 1.—If we calculate from the beginning of the kalpa or the caturyuga, there are in the epoch neither fractions of the adhimâsa months nor of ûnarâtra days; but as the great number of days embraced by such long periods makes the calculation wearisome, the methods set forth in this chapter start neither from the beginning of the kalpa nor from that of the caturyuga, but from dates chosen arbitrarily and nearer to the time for which they are to be employed. As such epochs are not free from fractions of the adhimâsa months and ûnarâtra days, these fractions must be taken into account (*Schram*).

P. 46, l. 27.—The numbers employed here do not belong to Brahmagupta's, but to Pulisa's system. The year taken as epoch is the year 587 Śakakâla. As we have seen, p. 31, ll. 8–10, that in the moment of the beginning of our gauge-date or of the year Śakakâla 953, there have elapsed 3,244,132 years of the caturyuga, there must have elapsed

3,243,766 years of the caturyuga till the beginning of the year 587 Śakakâla. We must now first calculate the adhimâsa months and ûnarâtra days for this epoch. After Pulisa's method (p. 41, l. 29), we have: 3,243,766 years are equal to 38,925,192 solar months or 1,167,755,760 solar days. This number multiplied by 271 and divided by 4,050,000 gives $78{,}138\frac{4043}{5625}$. As here the nearest number is to be taken, we get 78,139, which, subtracted from 1,167,755,760, gives 1,167,677,621. This latter number divided by 976 gives as the number of adhimâsa months $1{,}196{,}391\frac{5}{976}$. Now 1,196,391 adhimâsa months are equal to 35,891,730 adhimâsa days, which, added to 1,167,755,760 solar days, give 1,203,647,490 lunar days. According to Pulisa's theory (see p. 26, l. 9), there are in a caturyuga 1,603,000,080 lunar and 25,082,280 ûnarâtra days; so one ûnarâtra day sums up in $63\frac{63379}{69673}$ lunar days. Therefore we should have to divide the given number of lunar days L by $63\frac{63379}{69673}$, but we prefer to subtract from L a certain number X, and to divide the rest by $63\frac{10}{11}$ or $\frac{703}{11}$. The number X will be given by the equation $\frac{L}{63\frac{63379}{69673}}=\frac{L-X}{\frac{703}{11}}=\frac{11\ L-11\ X}{703}$. This equation gives for X the value $X=\left(\frac{\frac{439}{69673}}{703\frac{439}{69673}}\right)L$ or $X=\left(\frac{439}{48980558}\right)L$ or $X=\left(\frac{1}{111573\frac{11}{439}}\right)L$, or nearly $11\ X=\frac{11\ L}{111573}$.

Now L being equal to 1,203,647,490 lunar days, $11\ L$ will be equal to 13,240,122,390 lunar days; this number divided by 111,573 gives $118{,}667\frac{89199}{111573}$. Taking the nearest number, we subtract 118,668 from 13,240,122,390 and get 13,240,003,722, which divided by 703 gives $18{,}833{,}575\frac{497}{703}$ as the number of ûnarâtra days. This added to the 1,203,647,490 lunar days gives for the date of our epoch the number of civil days 1,184,813,915.

This number divided by 7 gives 5 as remainder. Now the last day before the present caturyuga was a Monday (see p. 33, l. 11), therefore the last day before our epoch is a Saturday, and any number of days elapsed since that epoch if divided by 7 will indicate by the remainder, the week-day counted from Sunday as 1, as it is said, p. 47, l. 19. Now the whole method is easily recognised as thoroughly correct. Instead of multiplying the partial solar days by $\frac{271}{4050000}$, we multiply them by $\frac{1}{14945}$, which is sufficiently correct, as $\frac{271}{4050000}$ is equal to $\frac{1}{14944\frac{176}{271}}$. As besides the whole adhimâsa months there is yet a fraction of $\frac{5}{976}$ adhimâsa months in our epoch, we add 5 before dividing by 976. The calculation of the ûnarâtra days has already been explained; but as in our epoch besides the whole ûnarâtra days there is still a fraction of $\frac{497}{703}$ ûnarâtra days, we must add 497 before dividing by 703. The whole proceeding is thus explained (*Schram*).

P. 48, l. 11.—The calculation has been made for the complete years elapsed *before* our gauge-date. So we get the week-day of the last day *before* the first Caitra of the gauge-date, and if this is a Wednesday, the first Caitra itself is a Thursday; *cf.* p. 30, l. 9.

The first day of this epoch corresponds to the day 1,964,031 of the Julian period. Adding 133,655 to 1,964,031, we have for the first Caitra 953 the day 2,097,686 of the Julian period, as it ought to be (*Schram*).

P. 48, l. 21.—The 18th Isfandârmadh of Yazdajird 399 corresponds in fact to Wednesday, 24th February 1031, the day before the first Caitra 953 Śakakâla (see note to p. 2, l. 17) (*Schram*).

P. 49, l. 22. *By six years.*—The Arabic manuscript has *seven* instead of *six*.

P. 50, l. 1.—The method here employed is based on Pulisa's theory. According to this theory, the solar days must be divided by $976\frac{4336}{65390}$ to get the adhimâsa months. Now $976\frac{4336}{65390}$ with sufficient accuracy is equal to $976\frac{2}{30}$ or $\frac{29282}{30}$.

If S represents the number of solar months, the solar days or 30 S are to be divided by $\frac{29282}{30}$, or, what is the same, 900 S must be divided by 29282.

To get the ûnarâtra days, the lunar days must be divided by $63\frac{63379}{69673}$ (see note to p. 46, l. 27). Now $63\frac{63379}{69673}$ is equal to $\frac{703\frac{439}{69673}}{11}$, or with sufficient accuracy $\frac{703\frac{2}{300}}{11}$, or at least equal to $\frac{210902}{2800}$. So the multiplications and divisions of this method are explained.

The constant numbers which are to be added, are inherent to the epoch. The year 888 Śakakâla corresponds to the year 3,244,067 of the caturyuga; 3,244,067 years are equal to 38,928,804 solar months, or 1,167,864,120 solar days. These solar months multiplied by 66,389 and divided by 2,160,000 give $1,196,502\frac{4063}{180000}$ adhimâsa months, or 35,895,060 adhimâsa days. This added to the 1,167,864,120 solar days gives 1,203,759,180 lunar days. Eleven times this number is equal to 13,241,350,980; this latter number divided by 111,573 gives $118678\frac{90486}{111573}$, or the nearest number 118,679. Subtracting this from 13,241,350,980, the remainder is 13,241,232,301, which being divided by 703, gives $18,835,323\frac{232}{703}$ ûnarâtra days; these days subtracted from the lunar days give for the number of civil days 1,184,923,857. Dividing this last number by 7, we get the remainder 5; and as the last day before the present caturyuga was a Monday (see p. 33, l. 11), the last day before the epoch here adopted is a Saturday, so that any number of days elapsed since that epoch, if divided by 7, will indicate by the remainder the week-day counted from Sunday as 1. The first day of this epoch corresponds to the day 2,073,973 of the Julian period. We have found in our epoch the fraction of adhimâsa month $\frac{4063}{180000}$, which is equal to $\frac{660\frac{172766}{180000}}{29282}$ or very nearly $\frac{661}{29282}$ adhimâsa month, so we must add 661 before dividing by 29282.

The fraction of ûnarâtra days $\frac{232}{703}$ is equal to $\frac{69,600\frac{464}{703}}{210902}$ or nearly to $\frac{69601}{210902}$. Therefore we must add 69,601 before dividing by 210,902. Alberuni has, instead of this number 69,601, the number 64,106, 4 instead of 9, and the last three numbers reversed (*Schram*).

P. 50, l. 35.—We had 780 months; adding thereto the 23 adhimâsa months, we have 803 months, which being multiplied by 30 give 24090, and not 24060 days. All the following faults are the consequences of this one (*Schram*).

P. 51, l. 2.—It ought to be "adding thereto 69,601, we get the sum 79,566,601. By dividing it by 210,902, we get the quotient 377, *i.e.* ûnarâtra days, and a remainder of $\frac{56547}{210902}$, *i.e.* the *avamas*." (In the Arabic text, p. ٣٧, 17, the reading of the MS. ought not to have been altered.) The correct result is 23,713 civil days. If we divide this number by 7, we find the remainder 4, which shows again that the last day before our gauge-date is a Wednesday. By adding 23,713 to 2,073,973, we get for the first Caitra 953 the day 2,097,686 of the Julian period, as it ought to be (*Schram*).

P. 51, l. 4.—Read 377, instead of 307.

P. 51, l. 9.—This method works with numbers much less accurate than the preceding ones. It is assumed that one adhimâsa month sums up in $32\frac{4}{7}$ solar months. So the solar months are divided by $32\frac{4}{7}$ or by $\frac{228}{7}$, or, what is the same, they are multiplied by $\frac{7}{228}$. For the time within which an ûnarâtra day sums up, there is simply taken $63\frac{10}{11}$, and the lunar days are divided by $63\frac{10}{11}$ or $\frac{703}{11}$, or, what is the same, multiplied by $\frac{11}{703}$. The epoch corresponds to the year 427 Śakakâla, or the year 3,243,606 of the caturyuga. This number of years is equal to 38,923,272 solar months, which, multiplied by 66,389 and divided by 2,160,000, give $1,196,331\frac{29789}{30000}$ adhimâsa months. The author has taken 1,196,332 adhimâsa months and neglected the little fraction $\frac{211}{30000}$, so that he has no fractions of adhimâsa months. These 1,196,332 adhimâsa months added to the 38,923,272 solar months give 40,119,604 lunar months or 1,203,588,120 lunar days. Multiplying by 11, we have 13,239,469,320, which divided by 111,573 gives $118,661\frac{105567}{111573}$ or 118,662. Subtracting this from 13,239,469,320, we have 13,239,350,658, which divided by 703 gives $18,832,646\frac{520}{703}$ for the number of ûnarâtra days. So the fraction of ûnarâtra days is $\frac{520}{703}$, very near to that adopted by the author of the method, viz., $\frac{514}{703}$. By subtracting the ûnarâtra days from the lunar days we get as the number of civil days 1,184,755,474, which is divisible by 7. So, as the last day before the caturyuga was Monday, the last day before this epoch is also Monday, and the number of days elapsed since this epoch if divided by 7, will give a remainder which indicates the week-day, counting Tuesday as 1. The first day of this epoch corresponds to the day 1,905,590 of the Julian period (*Schram*).

P. 51, l. 24.—It is easily understood why this method is called that of the Siddhânta of the Greeks. It is assumed that an adhimâsa month sums up in $32\frac{4}{7}$ or $\frac{228}{7}$ solar months. Now $\frac{228}{7}$ solar months are equal to $\frac{19}{7}$ solar years. Therefore this method is apparently an application of the cycle of nineteen years of the Greeks (*Schram*).

P. 52, l. 2.—32 months 17 days 8 ghaṭî and 34 cashaka are only another expression for $32\frac{4}{7}$ months (*Schram*).

P. 52, l. 10.—The number of civil days is 192096; dividing by 7, we have as remainder 2. As in this method (see note to p. 51, l. 9) Tuesday is to be reckoned as 1, this gives for the last day before our gauge-date Wednesday. Adding 192,096 to 1,905,590, we get as the first Caitra 953 the day 2,097,686 of the Julian period, as it ought to be (*Schram*).

P. 52, l. 20. *Al-harḳan.*—This book is mentioned only in this passage. The author calls it a *canon*, زيج, *i.e.* a collection of astronomical, chronological, and astrological tables and calculations. Whether it was an original composition in Arabic or translated from Sanskrit, and from what original, we do not learn from him. The word seems to be an Arabic rendering of *ahargaṇa.* Alberuni quotes from this book the computation of an era the epoch of which falls 40,081 days later than that of the Persian era, and compares it with the gauge-date (p. 53).

P. 52, l. 22.—If the epoch should fall 40,081 days after that of the era Yazdajird, it would fall on the first Caitra of the year 664 Śakakâla; but this is not the case. The first of Sha'bân of the year 197 coincides with the beginning of Vaiśâkha 735. As there are 72 years to be subtracted, we should come to Vaiśâkha 663, and to begin with the beginning of a year, the epoch must be postponed to Caitra 664. But this is of no importance, as we shall see that Alberuni altogether misunderstood the method here given (*Schram*).

P. 52, l. 24.—These two dates do not agree to a day. The first Ferwerdinmâh Yazdajird coincides with 16th June 632; 40,081 days later was Monday, 12th March 742, whilst the 21st Daimâh of the year 110 of Yazdajird corresponds to Sunday, 11th March 742. But as the date itself is erroneous, this is of no importance (*Schram*).

P. 52, l. 27.—As the numbers which form multiplications and divisions in this method are identical with those of the Pañca Siddhântikâ (p. 51), we can reckon the constants by the directions there given. The epoch of the method of Al-harkan is the beginning of Sha'bân of the year 197. But this date corresponds to the beginning of Vaiśakha 735 Śakakâla. So we should have for this date the following calculation:—Subtracting 427 from 735 years and 1 month, we get 308 years 1 month, or 3697 months; 3697 multiplied by 7 and divided by 228 gives for the number of adhimâsa months $113\frac{115}{228}$; the 113 adhimâsa months added to the 3697 solar months give 3810 lunar months or 114,300 lunar days. This number multiplied by 11 is 1,257,300; we add 514, which gives us 1,257,814; this divided by 703 gives for the number of ûnarâtra days $1789\frac{147}{703}$. So we should have all the numbers wanted for our epoch if, in fact, this epoch were the true epoch. But we have to add 864 months to the interval. Therefore these 864 months, which must always be added, must first be subtracted from the epoch, so that this latter is thrown back by 72 years. Now 72 years or 864 solar months multiplied by 7 and divided by 228 give the number of $26\frac{120}{228}$ adhimâsa months. These together with the 864 solar months are 890 lunar months or 26,700 lunar days, which multiplied by 11 and divided by 703 give $417\frac{549}{703}$ ûnarâtra days. So we have to subtract from the numbers first found $26\frac{120}{228}$ adhimâsa months and $417\frac{540}{703}$ ûnarâtra days. The number of adhimâsa months inherent to our true epoch will then be $113\frac{115}{228}-26\frac{120}{228}=86\frac{223}{228}$, or with sufficient accuracy 87 without a fraction, and the number of ûnarâtra days $1789\frac{147}{703}-417\frac{549}{703}=1371\frac{301}{703}$. Therefore no fraction is to be added to the adhimâsa months, whilst to the ûnarâtra days there must be added $\frac{301}{703}$, or nearly $\frac{11\times 28}{703}$. Therefore we must add 28 (not 38) before multiplying by $\frac{11}{703}$. The 114,300 lunar days of the first epoch diminished by the 26,700 lunar days of the 72 years, give 87,600 lunar days. Subtracting therefrom 1371 ûnarâtra days, we have 86,229 civil days, which being divided by 7 give as remainder 3. So the last day before this epoch is Thursday, and the number of days elapsed since the epoch of this method, if divided by 7, will give a remainder indicating the week-day, counting Friday as 1. The first day of this epoch corresponds to the day 1,991,819 of the Julian period (*Schram*).

P. 53, l. 1.—It must be 28, not 38 (see preceding note) (*Schram*).

P. 53, l. 6.—We must add 1, if we wish to have the week-day of the date itself, not that of the last day before it.

P. 53, l. 8.—Here Friday is considered as the first day of the week, not, as in the Indian books, Sunday. This ought to have been remarked (*Schram*).

P. 53, l. 9.—Alberuni's notes to this method of Alharkan are perhaps the weakest part of his work. His very first remark shows a complete misunderstanding of the whole calculation. The method is correct, for the months of the seventy-two years with which it begins are solar. If, as Alberuni would have them, they were lunar, and the rest of the months, as he understands it, were lunar too, then the calculation would simply be nonsense; for finding adhimâsa months is nothing else than finding the number which we must add to convert solar months into lunar ones. But when the months are already lunar, how can one add anything to them to make them once more lunar? (*Schram*).

P. 53, l. 15.—The example he works out is as erroneous as the remarks on the method itself. It must be clear to anybody who examines the method given on p. 52, that by the words (l. 29), "Add thereto the months which have elapsed between the first of Sha'bân of the year 197 and the first of the month in which you happen to be," there can only be meant solar months. The author fixed the initial epoch in his calendar by saying "1 Sha'bân 197," instead of fixing it in the Indian calendar by saying "first Vaiśakha 735." This accidental circumstance, which is of no consequence, induced Alberuni to think that he was to take the interval in lunar months, as the Arabic calendar has only lunar months, and he did not notice that lunar months in this part of the calculation would be absolutely impossible. He takes, in fact, in the example, the interval in lunar months, for there are 2695 lunar months between the first Sha'bân 197 and first Rabî' I. 422, and to these 2695 lunar months he adds the 864 months which he knows to be solar. Then he changes all these mingled months, of which the greatest part are already lunar, to lunar ones, as if they all were solar, and at last he wonders that the result is nonsense, and tries to amend the method. The only fault in the matter is that he did not understand the method.

If we wish to exemplify the method of the canon *Alharkan* in the case of our gauge-date, *i.e.* the first Caitra 953 Śakakâla, we must proceed as follows:—Subtracting from 953 years 735 years 1 month, we get as interval 217 years 11 months or 2615 solar months; adding thereto 864 solar months, we have 3479 solar months. This multiplied by 7 and divided by 228 gives for the number of adhimâsa months $106\frac{185}{228}$; adding the 106 adhimâsa months to the 3479 solar months, we get 3585 lunar months, or 107,550 lunar days. We add 28, and multiplying 107,578 by 11, we have 1,183,358, which number divided by 703 gives the number $1683\frac{209}{703}$ for the ûnarâtra days. Subtracting the 1683 ûnarâtra days from the 107,550 lunar days, we have 105,867 civil days. We add 1 in order to get the week-day of the first Caitra 953, and dividing by 7, we get as remainder 7. And as here Friday is considered as 1, so 7 corresponds to Thursday, and the first Caitra 953 is found to be Thursday. By adding 105,867 to 1,991,819 we have for the first Caitra of the year 953 the day 2,097,686 of the Julian period, as it ought to be (*Schram*).

P. 53, l. 33.—The emendation is as erroneous as the example was. The 25,958 days are counted from the epoch falling 40,081 days after that of Yazdajird to the first Sha'bân 197. But 25,958 days are equal to 879 Arabic months, or 73 years and 3 months. Further, he takes again the interval in lunar months, so that now in the amended method he has nothing but lunar months, which he changes to lunar months as if they were solar. So he gets a number which is, of course, absolutely erroneous, but he thinks it to be correct, for in the last instance he commits a new fault by *subtracting* 1 instead of adding it. And so by an accidental combination of different faults he finds by chance a week-day which agrees with that of the day before our gauge-date (*Schram*).

P. 54, l. 12.—As the multiplications and divisions of this method have already been explained in the note to pp. 36 and 37, we have here to account for the constant numbers only which are inherent to the epoch. The epoch is 854 Śakakâla, which corresponds to the year 1,972,948,033 of the kalpa. Multiplying 1,972,948,033 by 12, we find 23,675,376,396 solar months, which multiplied by 1,593,300,000, the adhimâsa months of a kalpa, and divided by 51,840,000,000, the solar months of a kalpa, give the quotient $727,661,597\frac{6463}{14400}$ as the number of adhimâsa months. Adding the 727,661,597 adhimâsa months to the 23,675,376,396 solar months, we have 24,403,037,993 lunar months or 732,091,139,790 lunar days. This latter number multiplied by 25,082,550,000, the ûnarâtra days of a kalpa, and divided by 1,602,999,000,000, the lunar days of a kalpa, gives for the number of ûnarâtra days $11,455,224,000\frac{347481}{356222}$. Subtracting the 11,455,224,000 ûnarâtra days from the 732,091,139,790 lunar days, we find as the number of civil days elapsed from the beginning of the kalpa to this epoch 720,635,915,790, a number which divided by 7 gives as remainder 0. So, as the last day preceding the kalpa was a Saturday (see p. 28, l. 31), the last day before this epoch is also a Saturday, and any number of days elapsed since this epoch, if divided by 7, shows by its remainder the week-day counted from Sunday as 1. The fraction of the adhimâsa months inherent to the epoch has been found to be $\frac{6463}{14400}$. Now $\frac{6463}{14400}$ is equal to $\frac{29\frac{2469}{14400}}{65}$, or very nearly $\frac{29}{65}$; so we add 29 before dividing by 65. The fraction of the ûnarâtra days is $\frac{347481}{356222}$. Now again $\frac{347481}{356222}$ is equal to $\frac{685\frac{267073}{356222}}{703}$, or nearly $\frac{686}{703}$; so we add 686 before dividing by 703.

The first day of this epoch coincides with the day 2,061,541 of the Julian period (*Schram*).

P. 55, l. 5.—This method consists in finding first the difference of the mean longitude of sun and moon. The numbers are Pulisa's. There are in a caturyuga 4,320,000 revolutions of the sun, and 57,753,336 revolutions of the moon. The difference, 53,433,336, is the number of lunar months. In every lunar month the moon gains one revolution or 360 degrees over the sun. Dividing 53,433,336 by the solar years 4,320,000, we find as the number of lunar months belonging to one solar year $12\frac{132778}{360000}$. So in every solar year the moon gains over the sun $12\frac{132778}{360000}$ revolutions.

Omitting the whole revolutions which have no interest, the moon gains over the sun $\frac{132778}{360000}$ revolutions, or, what is the same, $132\frac{778}{1000}$ degrees. Now $\frac{778}{1000}$ degrees are equal to $46\frac{68}{100}$ or to $46\frac{34}{50}$ minutes. So the moon gains over the sun in every solar year 132 degrees $46\frac{34}{50}$ minutes. By multiplying the number of years by 132 degrees $46\frac{34}{50}$ minutes, we find the number of degrees which the moon has gained in the given interval over the sun. Now if in the beginning of this epoch sun and moon had been together, this would be the difference of the mean longitude of sun and moon. But as this was only in the beginning of the caturyuga, but not at the moment of our epoch, there is an initial difference between the longitudes of sun and moon which must be added. Our epoch, or the year 821 Śakakâla, corresponds to the year 3,244,000 of the caturyuga. Multiplying 3,244,000 by the number of lunar months 53,433,336, and dividing by the number of solar years 4,320,000, we find that in these 3,244,000 years the moon gained over the sun $40{,}124{,}477\frac{112}{360}$ revolutions. Dropping again the whole revolutions, we see that the moon was in advance of the sun at the moment of our epoch by $\frac{112}{360}$ revolutions, or 112 degrees. Therefore these 112 degrees must be added, and all the numbers of this method find in this their explanation. The result for our gauge-date, 358° 41′ 46″, is the number of degrees, minutes, and seconds by which the moon is in advance of the sun at the moment of the beginning of the *solar* year 821, that is, in the moment when the sun enters Aries. As in the beginning of the luni-solar year sun and moon must have been in conjunction, the beginning of the luni-solar year has preceded that of the solar year by an interval which was just sufficient for the moon to make 358° 41′ 46″ in advance of the sun. Now as the moon gains 360 degrees in a lunar month or 30 lunar days, so she gains 12° in every lunar day. Therefore dividing 358° 41′ 46″ by 12, we get the number of lunar days and fractions by which the luni-solar year's beginning preceded that of the solar year. The fractions of the lunar days are changed to ghaṭis and cashakas. Thereby we get 29 days 53 ghaṭis 29 cashakas as the time by which the beginning of the luni-solar year preceded the sun's entering Aries, in agreement with the fraction of the adhimâsa month found on p. 31, l. 17. For $\frac{44837}{45000}$ adhimâsa months are also equal to 29 days 53 ghaṭis 29 cashakas. The number 27 days 23 ghaṭis 29 cashakas which he gives, p. 55, l. 25, is obtained by dividing 328° 41′ 46″, and not 358° 41′ 46″, by 12 (*Schram*).

P. 55, l. 17.—The Arabic manuscript has 328 instead of 358.

P. 55, l. 33.—The number is 132° $46\frac{34}{60}$, and not 132° 46′ 34″ (as the Arabic manuscript has). Therefore the *portio anni* is not 11° 3′ 52″ 50^{iii}, but 11 days 3 ghaṭis 53 cashakas 24″; and the *portio mensis* not 0° 55′ 19″ 24^{iii} 10^{iv}, but 0 days 55 ghaṭis 19 cashakas 27^{iii}.

The reason of this calculation is the following:—In a year or 12 solar months the moon gains over the sun 132° $46\frac{34}{60}$. As she gains 12 degrees in every lunar day, the twelfth part of these degrees will represent the sum of lunar days and their fractions which the solar year contains over 360, that is to say, the sum of adhimâsa days and their fractions. One solar month containing 0 adhimâsa days 55 ghaṭis 19 cashakas 27^{iii}, the number of solar months within which one adhimâsa month or 30 lunar days sum up, will be found by dividing 30 days by 0 days 55 ghaṭis 19 cashakas 27″. This gives 2 years 8 months 16 days 3 ghaṭi 55 cashaka.

P. 56, l. 1.—There must be a great lacuna, for the first lines of this page are absolutely without meaning. I am inclined to attribute this lacuna to the source whence the author drew this information, *i.e.* the Arabic translation of Karaṇasâra.

P. 59, l. 23.—The calculation should be made in the following manner:—The sum of days of the kaliyuga is multiplied by the star-cycles of a kalpa and divided by the civil days of a kalpa, viz., 1,577,916,450,000. So we get the revolutions and part of a revolution which the planet has made during the time elapsed since the beginning of the kaliyuga. But in the beginning of the kaliyuga all planets have not been in conjunction; this was only the case in the beginning of the kalpa. Therefore to the fractions of revolutions which the planet made since the beginning of the kaliyuga, we must add its place at this beginning itself, *i.e.* the fraction of a revolution which every planet had at the beginning of the kaliyuga, the whole revolutions being of no interest. But Brahmagupta adds these numbers before dividing by the civil days of the kalpa, and this is quite natural, both fractions having by this proceeding the same divisor. Therefore what he calls the *basis*, ought to be the fraction of every planet at the beginning of the kaliyuga multiplied by the civil days of the kalpa; but he has made a great mistake. Instead of multiplying the fractions by the civil *days* of a kalpa, viz., 1,577,916,450,000, he has multiplied them by the years of a kalpa, viz., 4,320,000,000. Therefore all numbers given on p. 60 as the *bases* are entirely erroneous. To find the fractions for each planet and the *bases* we have the following calculation:—From the beginning of the kalpa to that of the kaliyuga there have elapsed 1,972,944,000 years; so to get the places of the planets at the beginning of the kaliyuga we ought to multiply the revolutions of each planet by 1,972,944,000, and to divide them by the years of a kalpa, 4,320,000,000. As these two numbers have the common divisor 432,000, we multiply the revolutions of each planet by 4567 and divide them by 10,000. This will give us the place of the planet at the beginning of the kaliyuga. We have thus for the single planets:—

For Mars, 2,296,828,522 revolutions multiplied by 4567 and divided by 10,000 give 1,048,961,585$\frac{9974}{10000}$ revolutions; so the place of Mars at the beginning of the kaliyuga is $\frac{9974}{10000}$ of a revolution.

For Mercury, 17,936,998,984 revolutions multiplied by 4567 and divided by 10,000 give 8,191,827,435$\frac{9928}{10000}$ revolutions; so the place of Mercury is $\frac{9928}{10000}$ revolutions.

For Jupiter, 364,226,455 revolutions multiplied by 4567 and divided by 10,000 give 166,342,221$\frac{9985}{10000}$ revolutions; so his place is $\frac{9985}{10000}$ revolutions.

For Venus, 7,022,389,492 revolutions multiplied by 4567 and divided by 10,000 give 3,207,125,280$\frac{9964}{10000}$; so her place is $\frac{9964}{10000}$ revolutions.

For Saturn, 146,567,298 revolutions multiplied by 4567 and divided by 10,000 give 66,937,284$\frac{9966}{10000}$ revolutions; and his place is $\frac{9966}{10000}$ revolutions.

For the sun's apsis, 480 revolutions multiplied by 4567 and divided by 10,000 give 219$\frac{2160}{10000}$ revolutions; and its place is $\frac{2160}{10000}$ revolutions.

For the moon's apsis, 488,105,858 revolutions multiplied by 4567 and divided by 10,000 give 222,917,945$\frac{3486}{10000}$ revolutions; and its place is $\frac{3486}{10000}$ revolutions.

For the moon's node, 232,311,168 revolutions multiplied by 4567 and divided by 10,000 give 106,096,510$\frac{4256}{10000}$ revolutions; and its place is $\frac{4256}{10000}$ revolutions.

Multiplying now the place of every planet by 1,577,916,450,000, we get the following *bases* for the single planets:—

For Mars, 1,573,813,867,230.
„ Mercury, 1,566,555,451,560.
„ Jupiter, 1,575,549.575.325.
„ Venus, 1,572,235,950,780.
„ Saturn, 1,572,551.534,070.
„ the sun's apsis, 340,829,953,200.
„ the moon's apsis, 550,061,674,470.
„ the ascending node, 671,561,241,120 (*Schram*).

P. 67, l. 14. A.H. 161.—According to p. 15, the year was A.H. 154. *Cf.* note to i. 169.

P. 71.—With the orbits of the planets *cf.* *Sûrya-Siddhânta*, xii. 90, note.

Pp. 74 *seq.*—As for the Arabic terminology of these pages, it deserves to be noticed that—

(1.) الظل المعدّل means *the true distance* = Sanskrit *mandakarṇa*.

(2.) That الظل المقوّم means *the true distance of the shadow's end*; and

(3.) *Sinus totus*, جيب الكلّ = Sanskrit *trijîvâ* or *trijyâ*, means *the sinus of three zodiacal signs or 90 degrees, i.e.* the radius.

P. 74, ll. 17, 18.—Instead of TC = طج the Arabic manuscript has KC = كج, which has been corrected by Dr. Schram.

P. 75, l. 34.—The lacuna must be something like the following:—"For *KC* must be divided by the divisor kept in memory" (*Schram*).

P. 78, l. 27.—This and the two following passages are not clear. Alberuni does not seem to have understood the subject, for the shadow is neither the greatest nor the mean, but the true shadow; and the shadow from which one is to subtract, *i.e.* 1581, is nothing else than the earth's diameter, which also is neither the mean nor the greatest, but always the same (*Schram*).

P. 79.—*Alkhwârizmî* is mentioned here and ii. 114 (on the various colours of eclipses). According to *Fihrist*, p. ٢٧٤, he composed an epitome of the Sindhind (*Brahma-Siddhânta*). He is famous as the author of a work on algebra, edited by Rosen, London, 1831. *Cf.* also. L. Rodet, *L'Algèbre d'Alkhwârizmî et les Methodes Indienne et Grecque* ("Journal Asiatique," 101 (1878), pp. 5 *seq.*).

P. 82. *Two suns, two moons, &c.*—This theory, as well as the expression *fish* (a name for the polar star?), seem to be of Jaina origin. *Cf.* Colebrooke, "Essays," ii. 201.

P. 84.—*Cf.* with this table of the *Nakshatras* a paper of Thibaut, "The Number of the Stars constituting the several Nakshatras according to Brahmagupta, &c.," the "Indian Antiquary," 1885, p. 43; also Colebrooke, "Essays," ii. 284, and *Sûrya-Siddhânta*, p. 321.

P. 89, l. 32.—In the Arabic text, p. ٣٣٩, 15, read الف instead of الفين. The number of years is 1800, not 2800.

P. 90. *Kâlâmśaka.*—This term (also *kâlâmśa*) is explained in *Sûrya-Siddhânta*, note to ix. 5.

The work *Ghurrat-alzîjât*, only once mentioned, is perhaps identical with the *Kitâb-alghurra*, which Alberuni quotes in his "Chronology" (my translation, p. 15 *et passim*). Its author was Abû-Muḥammad Alnâ'ib Alâmulî, who has used the work of Ya'ḳûb Ibn Ṭâriḳ. *Cf.* note to i. 169.

P. 90, l. 21.—Emendation of the *khaṇḍakhâdyaka* (also on p. 91), *i.e.* Uttarakhaṇḍakhâdyaka.

On Vijayanandin (l. 26), the author of *Karaṇatilaka*, *cf.* note to i. p. 156.

P. 101.—The enumeration of mountains, here taken from the *Matsya-Purâṇa*, may be checked by the help of *Vishṇu-Purâṇa*, ii. 141, note 2, and ii. 191 *seq.* The last name is written *bahâshîr* in the Arabic, which I cannot identify with an Indian name. Perhaps it is a blunder for *mahâshîr*, which might represent *mahâśaila*. *Vide Vishṇu-Purâṇa*, II. iv. p. 197.

P. 101.—On the *Aurva* legend, *cf. Vishṇu-Purâṇa*, III. viii. p. 81, note.

P. 102.—The story of Soma, the husband of the daughters of Prajâpati (the lunar stations), occurs in its elements already in the Vedic period. *Cf.* H. Zimmer, *Altindisches Leben*, pp. 355, 375.

P. 104.—On the Hindu theory of ebb and flow, *cf. Vishṇu-Purâṇa*, ii. 203, 204. The two names, of which I have not found the Indian equivalents, are written *baharn* and *vuhar* in the Arabic.

P. 105. *The Vishṇu-Purâṇa says.*—The author seems to refer to *Vishṇu-Purâṇa*, II. iv. p. 204: "The rise and fall of the waters of the different seas is five hundred and ten (not 1500) inches" (or finger-breadths).

P. 106.—The author's theory of the origin of the Dîbajât has already been mentioned, vol. i. 233.

P. 110.—As to the strictures of the author on the sincerity of Brahmagupta, *cf.* note to p. 25 (here ii. p. 263). The passages which excited the indignation of Alberuni do not express the view of Brahmagupta, but were simply taken by him from older books—in fact, written *pûrvaśâstrânusârena*. *Cf.* Kern, translation of *Bṛihat-Saṁhitâ*, note to chap. iii. v. 4 (p. 445).

P. 114, l. 12. *Kinds of eclipses.*—Read instead of this, *colours of the eclipses.* On Alkhwârizmî, *cf.* note to ii. 79. What the author here mentions as a view of the Hindus, agrees literally with *Sûrya-Siddhânta*, vi. 23.

P. 116.—On the *Khaṇḍakhâdyaka*, the Sanskrit original of the Arabic *Sindhind*, *cf.* note to i. 153, 154.

P. 118.—On the *Bṛihajjâtakam* of Varâhamihira, *cf.* note to i. 219.

P. 119.—Rules for finding the dominants or regents of the day, month, and year are given in the *Sûrya-Siddhânta*, i. 51, 52; xii. 78, 79.

P. 120.—On the *srûdhava* (?) of Mahâdeva, not to be confounded with the book of the same title by Utpala, *cf.* note to i. 157.

P. 120. *Table of the serpents.*—The names of this table must be compared with the names in *Vishṇu-Purâṇa*, ii. 74, 285. The words *Suku* and *Cabrahasta* seem to be mistakes of the Arabic copyist for *Vâsuki* and *Cakrahasta.*

P. 121.—The names of the dominants of the planets are not known to me from a Sanskrit source. Therefore the pronunciation of some of them remains uncertain.

Pp. 121, 122.—The names of the dominants of the Nakshatras are given by A. Weber, *Ueber den Vedakalender Namens Jyotisham*, p. 94. *Cf.* also *Sûrya-Siddhânta*,

viii. 9, pp. 327 *seq.*, and *Vishṇu-Purâṇa*, II. viii., notes on pp. 276, 277.

Instead of *Mitra*, the deity presiding over Anurâdhâ, it would perhaps be better to write *Maitra*, and in the Arabic ميتر (*Vishṇu-Purâṇa*, ii. p. 277).

The latter part of this list in the Arabic text is not free from confusion.

The regent of Uttarabhâdrapadâ is placed side by side with Pûrvabhâdrapadâ, whilst the latter station is left without its regent, which is *aja ekapât* (*Sûrya-Siddhânta*, p. 343). A part of this word seems to be extant in the square for *aśvinî*, which has اشو كبار. Perhaps this is to be read *aśvin ajaikapâd*, اشو اجيكباد, in which case the Arabic copyist has made two blunders, dropping part of the word *ajaikapâd* and placing it in the wrong square.

P. 123.—On the sixty-years cycle *cf.* *Sûrya-Siddhânta*, i. 55, and xiv. 17; Varâhamihira, *Bṛihat-Saṁhitâ*, viii. 20–53.

P. 125.—For the names Samvatsara, Parivatsara, &c., *cf.* *Bṛihat-Saṁhitâ*, viii. 24; *Sûrya-Siddhânta*, xiv. 17, note; Weber, *Ueber den Vedakalender genannt Jyotisham*, p. 34–36.

Pp. 127, 128.—The dominants of the single *lustra* are given in *Bṛihat-Saṁhitâ*, chap. viii. 23.

The names of the single years exhibit some differences from the Sanskrit text (*Bṛihat-Saṁhitâ*, viii. 27–52).

No. 8, هابس instead of *bhâva*, has risen from a wrong division of the words of the text—

śrîmukhabhâvasâhvau,

i.e. *śrîmukha-bhâva-sâhvau*.

No. 9, جى instead of جو = *yuvan*, is perhaps a mistake of the copyist of the Arabic text.

No. 15, بش, *visha* (in Kern's edition *vṛisha*), is not a mistake, but a different reading. The word in brackets (*Vṛishabha*) is to be cancelled.

No. 18, نتُ, *natu*, cannot be combined with *pârthiva*. It corresponds to *nataṁ*. *Cf.* Kern's various readings to chap. viii. 35.

No. 30, جر. The name of the thirtieth year is *durmukha*. Perhaps the reading جر has risen from a wrong division of these words (viii. 38)—

manmatho 'sya parataśca durmukhaḥ,

so as to represent the elements *-ca dur-*.

No. 34, سرب (*śarva*), seems to be a mistake for *śarvari* or *sarvarin*.

No. 40, *parâvasu* is the reading of some manuscripts for *parabhâva*. *Cf.* Kern, various readings to viii. 41.

No. 48. This year is called *ânanda* by Kern, but the reading of Alberuni, *vikrama*, occurs also in Sanskrit manuscripts. *Cf.* various readings to viii. 45.

No. 56. The دبه of the text seems to be a blunder of the copyist for *dundubhi* (viii. 50).

No. 57, *aṁgâra* or *aṁgâri*, the reading of certain manuscripts instead of *udgâri* (viii. 50).

No. 58 and 60. The words كشاكر (instead of ركتاكر) and كر = *raktâksha* and *kshaya*, seem to be examples of a phonetic change between *sh* and *r*.

The same list of names is given in *Sûrya-Siddhânta*, i. 55, note.

P. 130.—With this chapter on the four parts of the life of a Brahman *cf.* *Vishṇu-Purâṇa*, book III. chap. ix.

P. 131.—The complete verse of Bashshâr is this—

> "The earth is dark, but the fire is bright,
> And the fire is worshipped, since there is fire."

This is the saying of a man whose parents had come as prisoners of war from Tukhâristân on the Upper Oxus, but he was born in Baṣra, and lived in Bagdad under the Khalif Almahdî. As he stood under the accusation of being a heretic (Zoroastrian or Manichæan), or, according to another version, because he had composed satirical verses on the Khalif, he was, notwithstanding his great age, sentenced to be beaten, and died in consequence, A.H. 167 = A.D. 784. *Cf.* Ibn Khallikân, *Vita*, No. 112.

P. 134, l. 1.—The south, as the direction foreboding evil, has already once been mentioned in connection with the islands Laṅkâ and Vaḍavâmukha, *vide* i. 307, 308.

Pp. 134, 135.—With this description of Âryâvarta *cf.* Manu, ii. 17 *seq.;* Vâsishṭha, i. 12; and Baudhâyana, i. 1, 9–12 ("Sacred Laws of the Âryas," translated by G. Bühler, Oxford, 1879–82).

P. 135.—On the vegetables which must not be eaten, *cf.* Manu, v. 5, and Vâsishṭha, xiv. 33. *Nâlî* seems to be = Sanskrit *nâlikâ.*

P. 136.—The contents of this chapter are nearly related to *Vishṇu-Purâṇa,* book III. chap. viii.

P. 137.—The story of King Râma, the Brahmin, and the *Caṇḍâla,* taken from the *Râmâyaṇa, vide* in Wilkins' "Hindu Mythology" (Calcutta, 1882), p. 319.

Pp. 137, 138.—The two quotations of Alberuni from the *Bhagavadgîtâ* can hardly be compared with any passage in the book in its present form. *Cf.* note to i. 29.

P. 139.—On the *aśvamedha* or horse-sacrifice, *cf.* Colebrooke, "Essays," i. 55, 56.

Pp. 140, 141.—This legend, as given on the authority of the *Vishṇu-Dharma,* is not known to me from a Sanskrit source.

P. 142.—As the original of this quotation from the *Purâṇas* is not known to me, the pronunciation of some of the proper nouns remains uncertain.

P. 143.—The story of Sagara, Bhagîratha, and the Ganges, is related by H. H. Wilson, "Works," vol. ii. p. 168. *Cf.* also Wilkins' "Hindu Mythology," p. 385. The source of this legend is the first book of *Râmâyaṇa.*

P. 145.—I do not know the original of this quotation from Varâhamihira's *Saṁhitâ.*

Pp. 145, 146.—The words here attributed to Śaunaka are probably taken from the *Vishṇu-Dharma.* *Cf.* note to i. 54.

P. 147.—The story of the head of Brehman is part of the legend of Śiva's fight with the Asura Jalandhara. *Cf.* Kennedy's "Researches," p. 456.

P. 149.—This and the following chapters treat of subjects which are discussed more or less in every Indian law-book, as in those of Manu, Âpastamba, Gautama, and others. Alberuni, however, does not seem to have drawn directly from any of these books, but rather from his own experience, from what his Pandits had told him, and what he himself had observed during his stay in India.

P. 153.—Alḥajjâj was governor of Babylonia during twenty years under the Omayyade Kalif 'Abdulmalik (684–704) and his son Alwalîd (704–714).

P. 153. *That a Brahmin and a Caṇḍâla are equal to him.*—*Cf.* the saying of Vyâsa, the son of Parâśara, here vol. i. p. 44.

P. 155.—On the forbidden degrees of marriage, *cf.* Manu, iii. 5.

P. 156.—On *garbâdhâna*, *sîmaṁtonnayanam*, *&c.*, *cf.* the *Dharmaśâstra* of Gautama, viii. 14; also the *Gṛihyasûtras* of Aśvalâyana, i. 13, 14.

P. 157. *Thus, when Kâbul was conquered, &c.*—The sentence added in brackets to indicate the meaning of the author's words, as I understand them, ought to run thus: "(which proves that he abhorred the eating of cows' meat and sodomy, but that he did not consider harlotry as anything baneful or unlawful)."

The detail in the history of Kâbul here alluded to is not known from other sources, *e.g.* *Balâdhurî.* During the Omayya Kaliphate of Damascus, both Kâbul and Sijistan bravely fought against the Muslims. During certain years they were subdued and had to pay tribute, but Kâbul always remained under the sway of its Hindu (Brahmin) kings of the Pâla dynasty. It was incorporated into the Khalif's empire under the Abbaside Ma'mûn; it had to receive a Muslim governor, but retained at his side the Hindu Shâh. The same double rule existed in Khwârizm.

About A.D. 950–975 the city of Kâbul was already Muslim, whilst the suburb was inhabited by the Hindus (and by Jews). Kâbul was the coronation-city for the Pâla dynasty, as Königsberg in Prussia for the Hohenzollerns. Even when they ceased to reside in Kâbul, they had to be crowned there.

By the Ispahbad, mentioned by Alberuni, I understand the Hindu governor who ruled over the city for the Pâla king. Our author applies a title of the Sasanian empire to the official of a Hindu empire.

In what year the negotiation referred to by Alberuni took place is not known. Perhaps under Ma'mûn, when the city was definitely ceded to the Muslim conquerors.

It seems to have been the public opinion among Muslims that Hindus considered fornication as lawful, as Ibn Khurdâdhbih expresses it (Elliot, "History of India," i. 13), whilst, according to Alberuni, they considered it indeed as unlawful, but were lax in punishing it.

P. 157.—The Buyide prince 'Aḍud-aldaula, who held Persia under his sway, died A.H. 372=A.D. 982. Not long before Alberuni wrote, the last of their dominions had been annexed to the empire of Mahmûd of Ghazna.

P. 158.—'Iyâs Ibn Mu'âwiya was judge in Baṣra under the Omayya Khalif Omar Ibn 'Abdala'zîz, and died there, A.H. 122=A.D. 740.

P. 159.—With the author's description of the ordeals, *cf.* Manu, viii. 114 *seq.*, and a translation of the chapter on ordeals from the *Vyâvahâra Mayûkha* by G. Bühler, in "Journal of the Asiatic Society of Bengal," 1867, vol. xxxv. pp. 14 *seq.*; Stenzler, *Die Indischen Gottesurtheile*, in *Zeitschrift der Deutschen Morgenländischen Gesellschaft*, ix. p. 661. The last-mentioned kind of ordeal (p. 160) is also described in Elliot's "History of India," i. 329 (the Sindian ordeal of fire).

P. 164. *According to a passage in the book Manu.*—*Cf.* Manu, ix. 118.

P. 166.—For the first quotation from *Phædo*, 81D, *cf.* note to i. p. 65. The second quotation can hardly be identified with any passage in *Phædo*. Perhaps it is derived from a commentary on the following words, 81C:—

ἀλλὰ διειλημμένην γε, οἶμαι, ὑπὸ τοῦ σωματοειδοῦς, ὃ αὐτῇ ἡ ὁμιλία τε καὶ συνουσία τοῦ σώματος διὰ τὸ ἀεὶ ξυνεῖναι καὶ διὰ τὴν πολλὴν μελέτην ἐνεποίησε ξύμφυτον.

P. 167.—The quotation from *Phædo* is found 115C–116A:—

Θάπτωμεν δέ σε τίνα τρόπον; ὅπως ἄν, ἔφη, βούλησθε, ἐάνπερ γε λάβητέ με καὶ μὴ ἐκφύγω ὑμᾶς, κ.τ.λ.

ἐγγυήσασθε οὖν με πρὸς Κρίτωνα, ἔφη, τὴν ἐναντίαν ἐγγύην ἢ ἣν οὗτος πρὸς δικαστὰς ἠγγυᾶτο, οὗτος μὲν γὰρ ἦ μὴν παραμενεῖν. ὑμεῖς δὲ ἦ μὴν μὴ παραμενεῖν ἐγγυήσασθε, ἐπειδὰν ἀποθάνω, ἀλλὰ οἰχήσεσθαι ἀπιόντα, ἵνα Κρίτων ῥᾷον φέρῃ, καὶ μὴ ὁρῶν μου τὸ σῶμα ἢ καιόμενον ἢ κατορυττόμενον ἀγανακτῇ ὑπὲρ ἐμοῦ ὡς δεινὰ πάσχοντος μηδὲ λέγῃ ἐν τῇ ταφῇ, ὡς ἢ προτίθεται Σωκράτη ἢ ἐκφέρει ἢ κατορύττει, κ.τ.λ.

ἀλλὰ θαρρεῖν τε χρὴ καὶ φάναι τοὐμὸν σῶμα θάπτειν καὶ θάπτειν οὕτως, ὅπως ἄν σοι φίλον ᾖ καὶ μάλιστα ἡγῇ νόμιμον εἶναι.

P. 168. *Galenus, &c.*—I do not know the Greek original of this quotation. *Cf.* note to i. p. 35.

P. 69.—The words of Vâsudeva are a quotation from *Bhagavad-Gîtâ*, viii. 24.

P. 171. *Johannes Grammaticus.*—*Cf.* note to i. 36.

P. 171.—The two quotations from *Phædo* are found in 62C:—

ἴσως τοίνον ταύτῃ οὐκ ἄλογον μὴ πρότερον αὐτὸν ἀποκτιννύναι δεῖν, πρὶν ἀνάγκην τινὰ θεὸς ἐπιπέμψῃ, ὥσπερ καὶ τὴν νῦν ἡμῖν παροῦσαν.

And 62B:—

ὡς ἔν τινι φρουρᾷ ἐσμεν οἱ ἄνθρωποι καὶ οὐ δεῖ δὴ *ἑαυτὸν ἐκ ταύτης λύειν οὐδ' ἀποδιδράσκειν, κ.τ.λ. τὸ θεοὺς εἶναι ἡμῶν τοὺς ἐπιμελουμένους καὶ ἡμᾶς τοὺς ἀνθρώπους ἓν τῶν κτημάτων τοῖς θεοῖς εἶναι.*

P. 174.—For the *Vishṇu-Purâṇa*, *vide* note to i. 54. The reading *Duve* is not certain, as the Arabic text has only دوى.

The names *Dilîpa*, *Dushyanta*, and *Yayâti* have been verified by means of the index to *Vishṇu-Purâṇa*.

P. 175, last line.—On the festival of the birth of Vâsudeva-Kṛishṇa (*Kṛishṇajanmâshṭamî*), *cf.* Weber, "Indian Antiquary," 1874, p. 21; 1877, p. 161; *Zeitschrift der Deutschen Morgenländischen Gesellschaft*, vi. p. 92.

P. 176, l. 11.—The Arabic manuscript has اتج, *i.e.* *âtaj*. For the word *aṭṭâṭaja*, *cf.* H. H. Wilson, "Essays and Lectures," ii. 232.

P. 176, l. 19. *Devasînî*.—The latter half of this word is apparently a derivation from the root *svap* = to sleep. In Prakrit *sleep* = *siviṇo* (Sanskrit *svapna*). *Vide Vararuci*, i. 3.

P. 177, l. 20.—*Deotthînî*, also called *deotthân* and *diṭṭhwan*. *Cf.* H. H. Wilson, "Glossary of Technical Terms," pp. 133, 134, 143, and "Memoirs on the History, Folklore, and Distribution of the Races of the North-Western Provinces of India," by H. Elliot, edited by J. Beames, i. 245.

P. 177.—The here-mentioned *bhîshma-pañca-râtri* seems to be identical with the *bhîshma-pañcakam* mentioned by Wilson, "Essays and Lectures," ii. 203.

P. 177.—The name *Gaur-t-r*, كورتر, occurs also ii. 179, and is apparently a vernacular form for *gaurî-tṛitîyâ*. *Cf.* Wilson, *l. l.* p. 185.

P. 178.—With this calendar of festivals are to be compared the treatise of H. H. Wilson, "The Religious Festivals of the Hindus," in his "Essays and Lectures," ii. p. 151 *seq.*, and Garcin de Tassy, *Notice sur les fêtes popu-*

laires des Hindous, Paris, 1834. This chapter, as well as the preceding one, would perhaps receive much light from the *Jyotirvidhâbharaṇam*, chap. xxi. *Cf.* Weber, "Journal of the German Oriental Society," vol. xxii. p. 719, and xxiv. p. 399.

This chapter has been translated into Persian by Abû-Sa'îd Gardezî (manuscript of the Bodleian Library in Oxford, Ouseley 240). *Cf.* note to ii. 6.

P. 178. *Agdûs.*—The Arabic has only اكدوس, which might be something like *ajya-divasa.*

Muttai.—This pronunciation is given by the manuscript. The name, not to be confounded with the Arabic name *Mattâ* (Matthæus), is perhaps identical with the name of a prince of Siwistan mentioned by Elliot, "History of India," i. 145–153.

Hindolî-caitra.—*Cf.* *Dola-yâtrâ* or *Holî* of Wilson, p. 223.

Bahand.—*Vide* Wilson, *l. c.*, and *vasanta*, here ii. 179.

P. 179. *Gaur-t-r.*—*Cf.* note to ii. 177.

P. 180. *Gâihat* (?), &c.—In the Arabic text the word ما must be added before طعام.

In the following line there is a lacuna, which in my translation I have filled up by the help of the Persian translation of Gardêzî which runs thus:—
كاهت بود (sic) واين روز هشتم بود كه اندر اين روز زندانيان را طعام دهند. In another place Gardêzî writes كاهت.

P. 181.—On *Jîvaśarman*, *cf.* note to i. 164.

P. 182. *Kîrî* (?).—This is perhaps only a misspelling of the Arabic copyist for كندى, *Kandî* (*Gandî Ribâṭ-ala'mîr*). *Cf.* note to i. 317, and Elliot, "History of India," ii. 112, 150; iv. 138; *Baihakî*, ed. Morley, p. 274. It is the place where King Mas'ûd was murdered.

Pp. 182. *Dîbâlî*=*dîpâvali* (row of lamps).—*Cf.* Wilson, "Glossary of Technical Terms," p. 114. Gardezî has ديوالى, *dîvâlî.*

P. 183. *Sâgârtam* = *śâkâshṭamî*.—*Cf.* Wilson, "Essays," ii. 208.

P. 183.—*Câmdha* seems to be = *caturdaśî mâgha*, *mânsartagu* = *mânsâshṭaka*, *pûrârtaku* = *pûrâshṭaka*, and *mâhâtan* = *mâghâshṭamî*. *Cf.* Wilson, "Essays," ii. 183, 184, 181.

P. 183.—The festival *dhola* seems to be identical with *holi*, *holikâ* or *dol-jâtrâ*. *Cf.* Wilson, p. 147, 210. Instead of *dhola* the Persian translation of Gardêzî has هولى, *hôlî*.

P. 184. *Śivarâtri*.—*Cf.* Wilson, p. 210.

P. 184.—*Pûyattanu* is perhaps = *pûpâshṭamî*. Cf. *pûpâshṭakâ*.

P. 186.—On the 15th Mâgha, as the beginning of kaliyuga, *cf.* Wilson, "Essays and Lectures," ii. p. 208. Alberuni seems to have taken his information regarding the *yugâdyâ* or beginning of a *yuga* from *Vishṇu-Purâṇa*, III. chap. xiv. p. 168.

P. 187, l. 5.—The number of lunar days, 1,603,000,010 (*sic* MS.), must, according to Dr. Schram, be altered to 1,603,000,080.

P. 188. *Vishuva*.—On the use of this term in astronomy, *cf.* *Sûrya-Siddhânta*, iii. 6, note.

P. 188.—On *Samaya* (?), *cf.* note to i. 336.

P. 189, l. 17, after the table.—The solar year is 365 days $15^{\text{I}}\ 30^{\text{II}}\ 22^{\text{III}}\ 30^{\text{IV}}$, not 365 days $30^{\text{I}}\ 22^{\text{II}}\ 30^{\text{III}}\ 0^{\text{IV}}$. Accordingly the last line must run thus: "(*i.e.* 1 day $15^{\text{I}}\ 30^{\text{II}}\ 22^{\text{III}}\ 30^{\text{IV}}$ are equal to $\frac{4027}{15600}$)" (*Schram*).

P. 190, l. 7.—The *bhâgahâra* is not 572, as the manuscript has, but 576, and the fraction $\frac{725}{576}$ (*Schram*).

P. 190.—*Auliatta* (?). The name is written اولسه بن سهاوى. A more literal rendering is this: "And that which A. the son of S. has dictated of the same (subject), is based on the theory of Pulisa." This author seems to have been contemporaneous with Alberuni, as also Samaya (ii. 188).

P. 190. *Varâhamihira.*—*Cf.* note to i. 54.
The term *shaḍaśîtimukha* is explained in *Sûrya-Siddhânta*, xiv. 6, note.

P. 191.—On the *Parvan*, *cf.* chap. lx.

P. 192. *Saṁhitâ.*—The author quotes here the *Bṛihat-Saṁhitâ*, chap. xxxii. 24–26.

P. 192.—On the book *Srûdhava*, *cf.* note to i. 157 and ii. 120. Is the word = *sarvadhara?*

P. 194.—With the theory of the *karaṇas*, cf. *Sûrya-Siddhânta*, ii. 67–69.

P. 195.—For an explanation of the term *bhukti*, *cf.* *Sûrya-Siddhânta*, i. 27, note.

P. 197.—The names of the *common karaṇas* are found in *Sûrya-Siddhânta*, ii. 69, note.
The other names are Indian numerals of a vernacular stamp. The corresponding Sindhî forms are *barkhu* (?), *biô*, *ṭriô*, *cothõ*, *panjõ*, *chahô*, *satõ*, *athõ*, *nãõ*, *ḍahõ*, *yârhõ*, *bârhõ*, *têrhõ*, *coḍhõ*. *Cf.* Trumpp, "Sindhi Grammar," pp. 158, 174. The form *pancâhî* (= the 15th) has, as far as I can see, no analogy in the vernacular dialects.

P. 199.—*Saṁkrânti* means the sun's entrance into a sign of the zodiac. *Cf.* *Sûrya-Siddhânta*, xiv. 10, note.

P. 200. *Alkindî.*—The way in which this scholar has transformed the Hindu theory of the *karaṇas* is instructive, as showing how Indian subjects were handled by the Arabs before Alberuni, even by the most learned and enlightened among them. The first knowledge of these things was probably communicated to the Arabs by the translation of the *Brahma-Siddhânta* (*Sindhind*) and *Khaṇḍakhâdyaka* (*Arkand*) of Brahmagupta. On Alkindi, *cf.*

G. Flügel, *Alkindî, genannt der Philosoph der Araber*, Leipzig, 1857 (in vol. i. of the *Abhandlungen für die Kunde des Morgenlandes*).

P. 201.—The names of the *vishṭis*, as taken from the *Srûdhava* (of Mahâdeva?—*cf.* note to ii. 120), are not known to me from a Sanskrit source. However, *vaḍavâmukha*, *ghora*, and *kâlarâtri* seem to be certain. The words بلو and جوال might be *plava* and *jvâla*, but كرّال?

The other series of names of the *vishṭis*, according to Alkindî, which by a mistake have been omitted in the Arabic text, may be transliterated in this way:—

(1.) Shûlpî (*śûlapadî?*).
(2.) Jamadûd (*yâmyodadhi?*).
(3.) Ghora.
(4.) Nastarînish.
(5.) Dârunî (*dhâriṇî?*).
(6.) Kayâlî.
(7.) Bahayâmani.
(8.) Bikata (*vyakta?*).

P. 204. *On the yogas*.—The contents of this chapter are near akin to those of chap. xi. of the *Sûrya-Siddhânta*. Compare also in the same book ii. 65, 66. The technical term *pâta*, which literally means *fall* (for its astrological meaning, *cf. l. c.* xi. 5, note), has in Arabic been rendered by the word سقوط, *i.e. falling* (page ٣, 11, 24), here ii. 207, 208, 209. In the Arabic text on p. ٣٩, 7, read بدل instead of بدلة, and to the word بهدوس, l. 16, it must be added that the manuscript has بهدران.

P. 205.—On the *Karaṇatilaka* of Vijayanandin, *cf.* note to i. 156.

P. 207.—The *bhuktyantara* has been explained, ii. 195.

P. 208.—*Syâvabala* (?) seems to have been a Hindu from Kashmîr who had become a Muslim, and wanted, by means of an *Arabic* book, to be informed on certain chapters of *Hindu* astrology. The pronunciation *Syâvabala* is not certain. The Arabic manuscript has *siyâwpal*.

P. 208.—On the Brahmin *Bhaṭṭila*, *cf.* note to i. 157. The names of the yogas which he mentions are not known to me from other sources. The names *gaṇḍânta*, *kâladaṇḍa*, and *vaidhṛita* are certain, and *barh* is probably *varsha.*

P. 209.—On Śrîpâla, *cf.* note to i. 164.

P. 210.—With the names of this table *cf. Sûrya-Siddhânta*, ii. 65, note (also p. 432). The جكر of the Arabic seems to be a mistake for جكم, *vishkambha;* No. 15, كنند, a mistake for كند, *gaṇḍa.*

Instead of *âyushmant* (name of the third yoga), the Arabic has راژكم (*râjakama?*); instead of *vyatipâta* it has كتاپ (*gatipâta?*).

P. 211.—The contents of this astrological chapter are principally taken from the *Laghujâtakam* (*i.e.* the smaller book of nativity) by Varâhamihira, of which the chapters i. ii. have been translated [illegible] A. Weber (*Indische Studien*, 2, 277 *seq.*), whilst the remainder has been translated by H. Jacobi (*De Astrologiæ Indicæ* horâ *appellatæ originibus. Accedunt Laghujâtaki capita inedita* iii.–xii., Bonn, 1872). Alberuni does not always adhere to the order of the paragraphs which we have in the Sanskrit text, and for certain parts he seems to have drawn from some commentary.

The exact meaning of the term *seconds of the stars* (the same page, ll. 23, 24), ثوانى النجوم, is not known to me.

Pp. 213–215.—The *table of planets* is taken from chapters ii. iii. iv. of the *Laghujâtakam.*

For the reading of the terms *naisargika*, *vimiśra*, and *shaḍâya* (p. 215), I am indebted to Prof. H. Jacobi, Kiel.

The number 25, كه, in the column with the heading *The scale of their magnitude*, seems to be a mistake for 3, ج.

Pp. 217–219.—This table of the zodiacal signs has been taken from *Laghujâtakam*, chap. i.

Pp. 221, 222.—This table of the *Houses* has been taken from *Laghujâtakam*, chap. i. 15.

P. 234.—The notes on comets and other meteorological subjects, with which the author concludes his book, have been taken from the *Bṛihat-Saṁhitâ* of Varâhamihira.

Pp. 237–238.—This table of comets is taken from *Bṛihat-Saṁhitâ*, chap. xi. 10–28.

The *children of the fire* are called *hutâśanasutâḥ* in Sanskrit, in Arabic اولاد الشتان, which I cannot explain.

Pp. 241–244.—This table of comets is taken from *Bṛihat-Saṁhitâ*, chap. xi. 29–51.

The reading بممكيس, instead of *padmaketu*, seems to be a mistake of the copyist for بدمكيس.

P. 245. *Book of the medicine of elephants.*—On this and similar literature, *cf.* A. Weber, *Vorlesungen über Indische Literaturgeschichte*, p. 289.

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